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Vihtari

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(54) **SESSION BASED SUPPORT OF MULTIPLE 3GPP STANDARDS VERSIONS**

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H04W 76/00 (2009.01)

(52) **U.S. Cl.**
USPC **709/227**; 370/328

(58) **Field of Classification Search**
USPC 709/227
See application file for complete search history.

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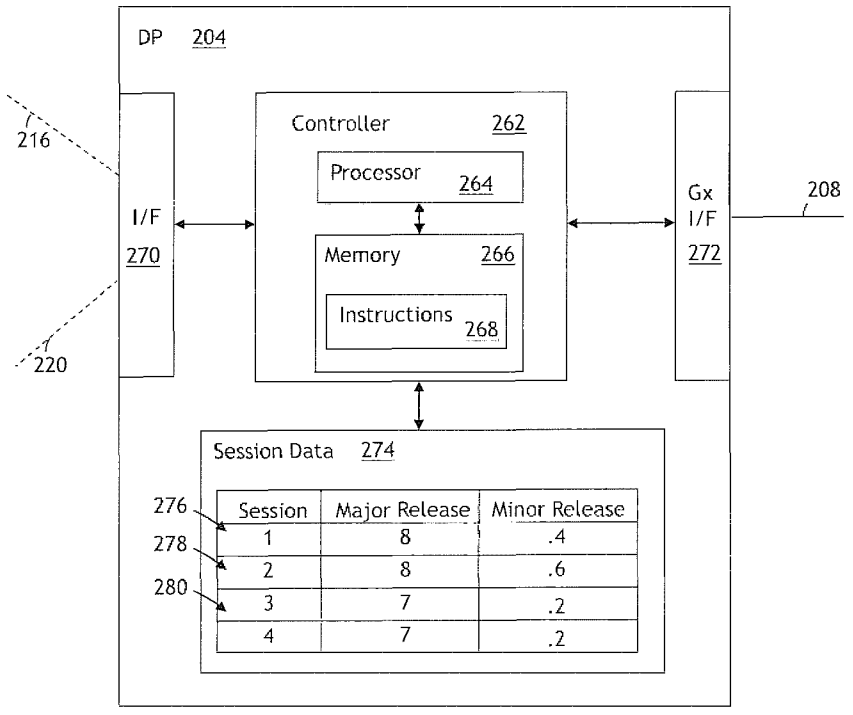
(57) **ABSTRACT**

Embodiments are disclosed that enable a device such as a policy and charging rules function (PCRF) node to operate with other nodes in a long term evolution (LTE) network that are operating at different respective major-minor release combinations of the 3rd Generation Partnership Project (3GPP) standards. Some embodiments enable such a device to operate with another network node at a given major-minor release combination of the 3GPP standards with respect to one session being managed by the device and at another major-minor release combination of the 3GPP standards with respect to another session. Some embodiments enable the major-minor release combination to be specified by first and second attribute value pairs (AVPs) respectively indicating the major and minor release identifiers of the major-minor release combination when a new session is requested, thereby providing greater flexibility for establishing sessions.

27 Claims, 17 Drawing Sheets



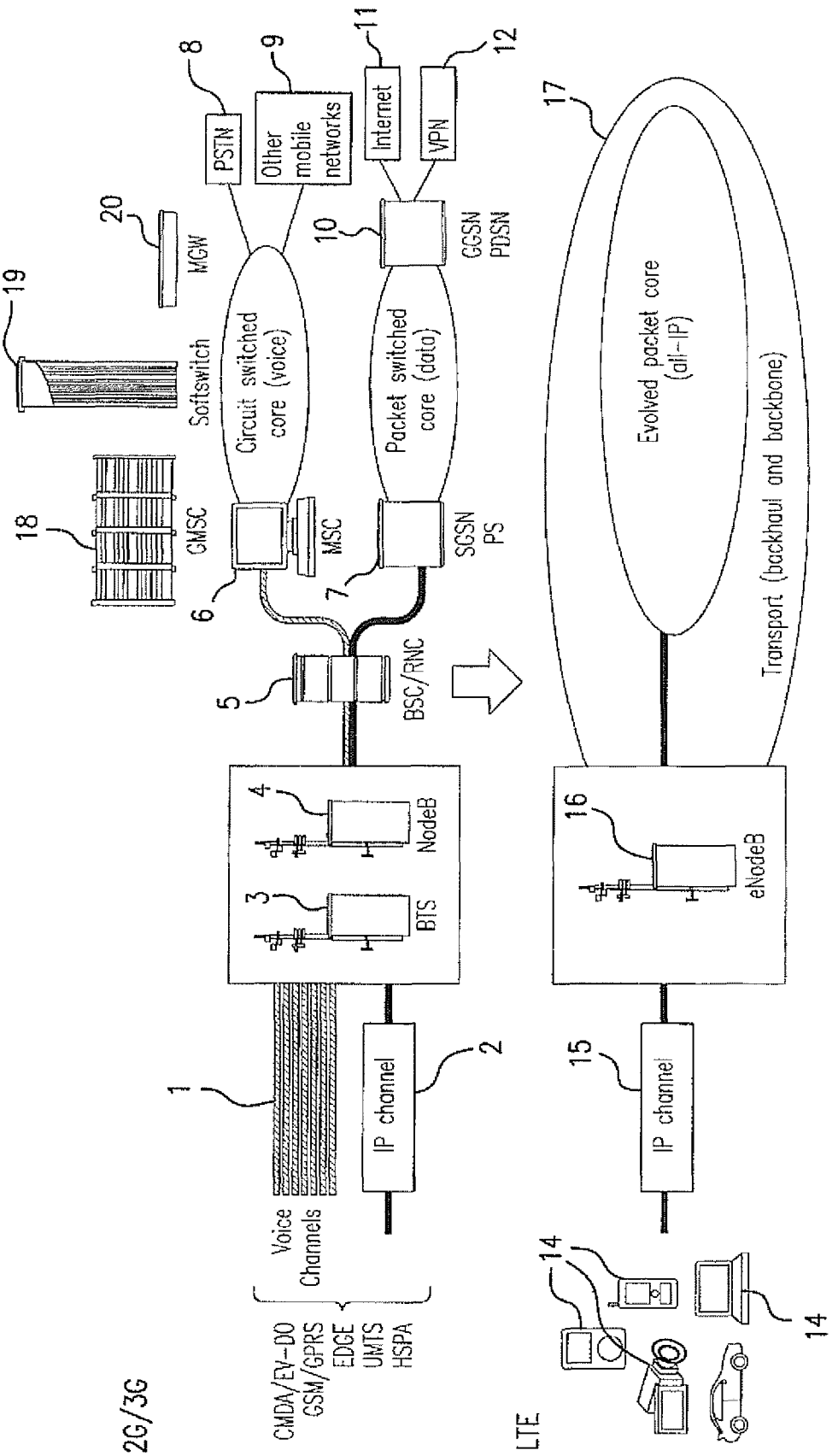

2G/3G
LTE
CMDA/EV-DO
GSM/GPRS
EDGE
UMTS
HSPA
Voice
Channels
IP channel
BTS
NodeB
BSC/RNC
GMSC
MSC
SGSN
PS
GGSN
PDSN
Softswitch
MGW
Circuit switched
core (voice)
Packet switched
core (data)
PSTN
Other
mobile
networks
Internet
VPN
Evolved packet core
(all-IP)
Transport (backhaul and backbone)
eNodeB
IP channel
1
2
3
4
5
6
7
8
9
10
11
12
14
15
16
17
18
19
20

FIG. 1

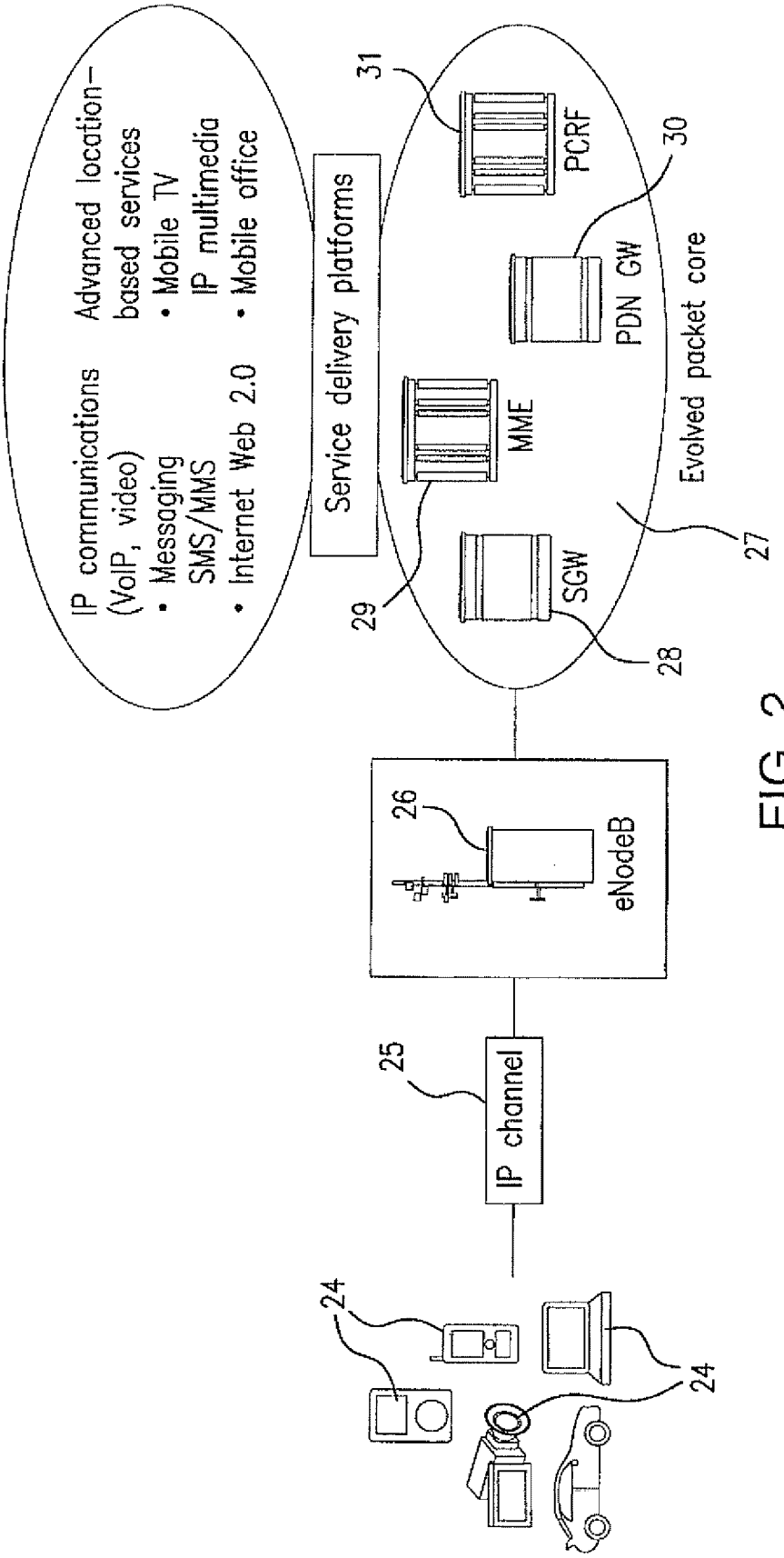

IP communications (VoIP, video)
• Messaging SMS/MMS
• Internet Web 2.0
Advanced location-based services
• Mobile TV IP multimedia
• Mobile office
Service delivery platforms
31
PCRF
30
PDN GW
MME
29
SGW
28
27
Evolved packet core
26
eNodeB
25
IP channel
24
24

FIG. 2

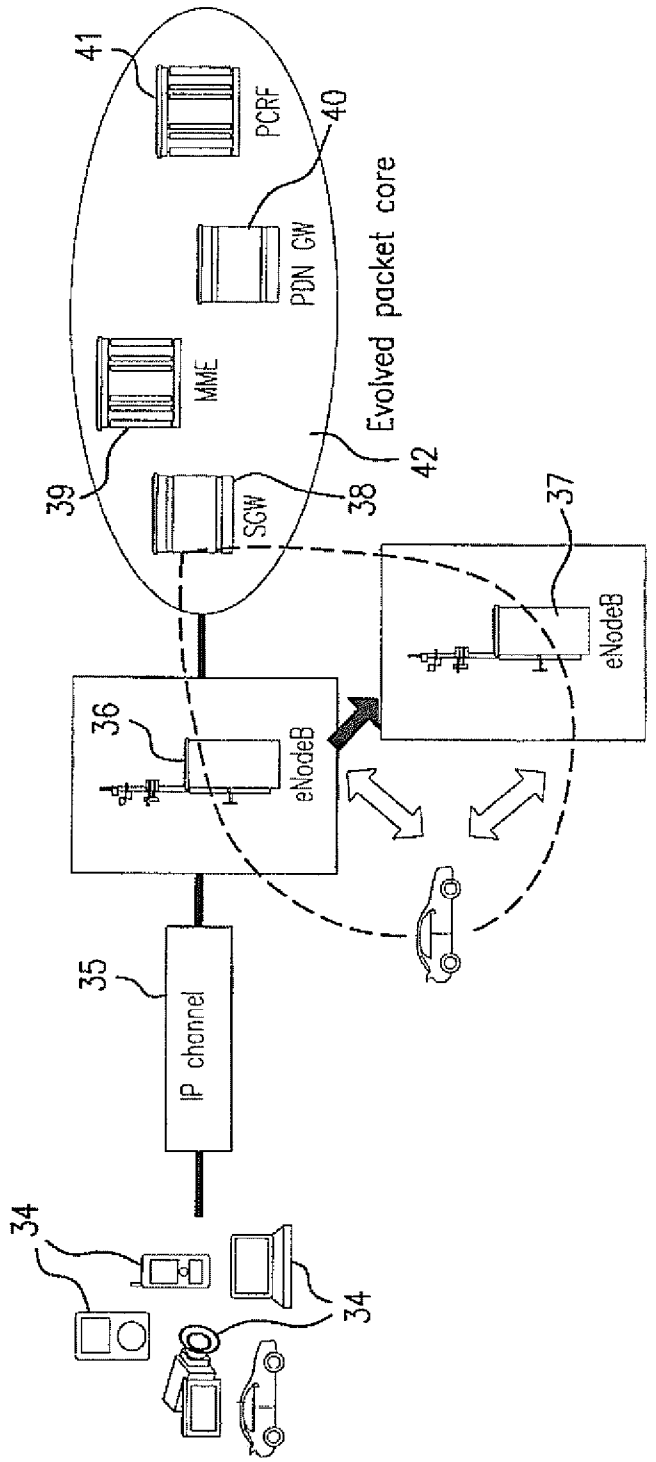

41
PCRF
40
PDN GW
MME
Evolved packet core
42
39
SGW
38
37
eNodeB
36
eNodeB
35
IP channel
34
34

FIG. 3

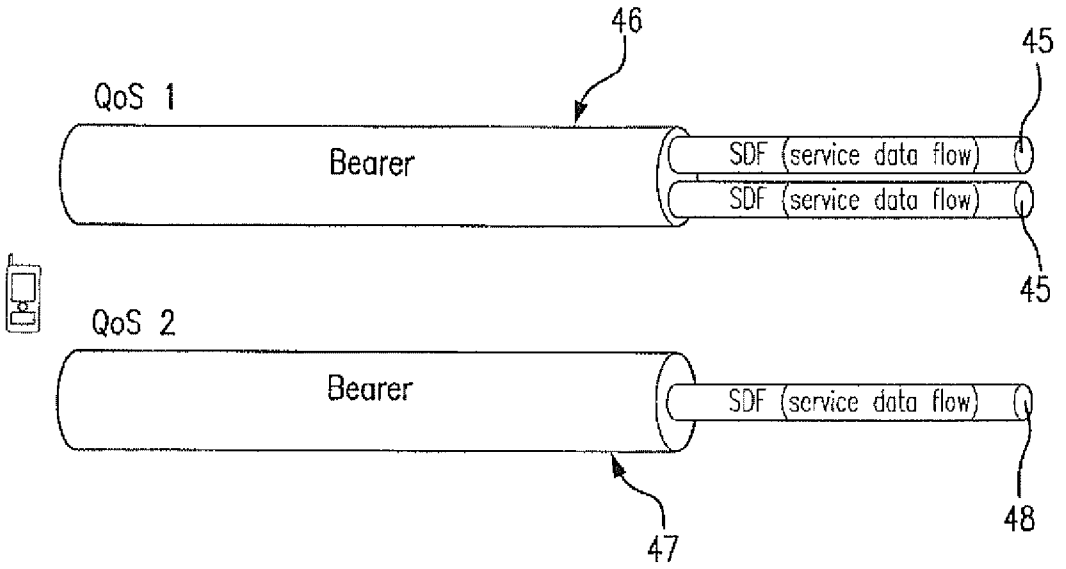

46
45
QoS 1
Bearer
SDF (service data flow)
SDF (service data flow)
45
QoS 2
Bearer
SDF (service data flow)
47
48

FIG. 4

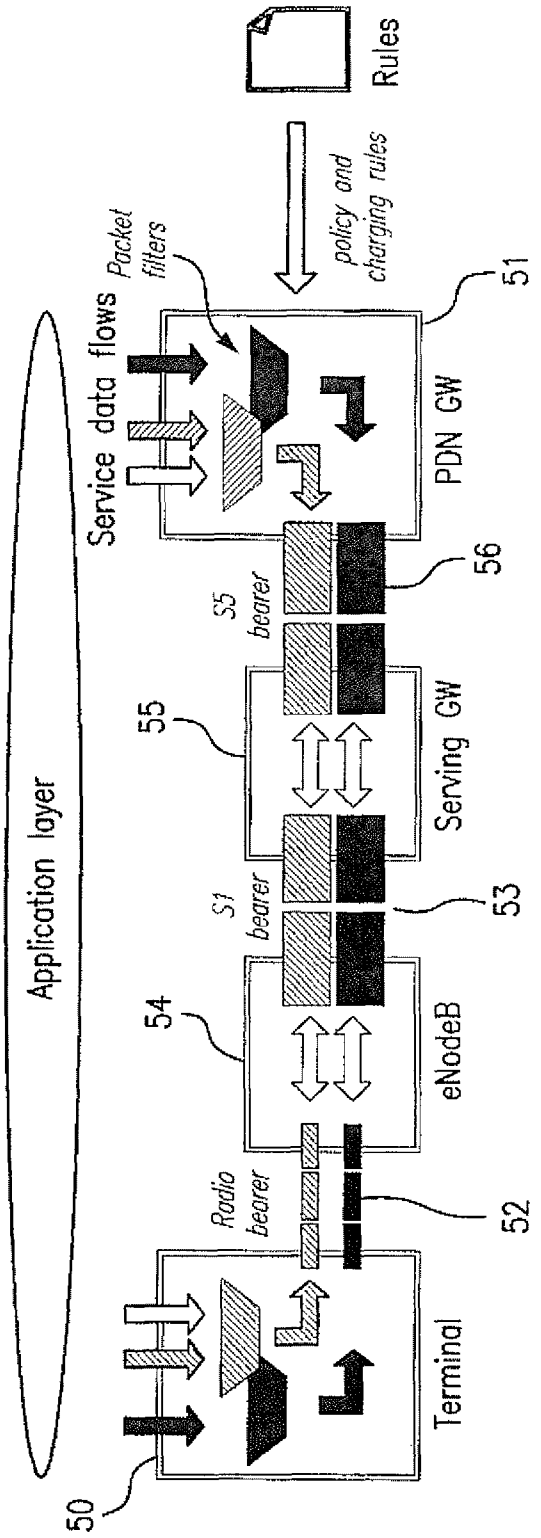

Rules
policy and charging rules
Packet filters
Service data flows
Application layer
PDN GW
51
S5 bearer
56
55
Serving GW
S1 bearer
53
54
eNodeB
Radio bearer
52
Terminal
50

FIG. 5

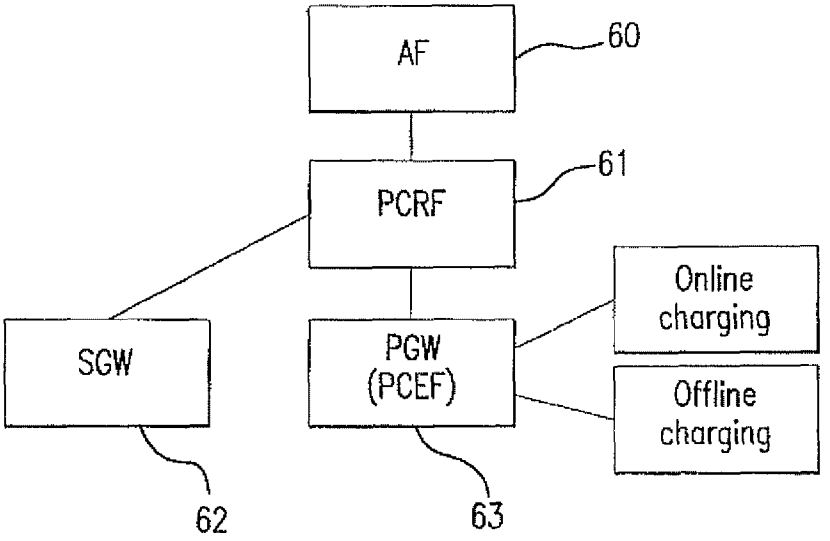

AF
60
PCRF
61
SGW
PGW
(PCEF)
Online
charging
Offline
charging
62
63

FIG. 6

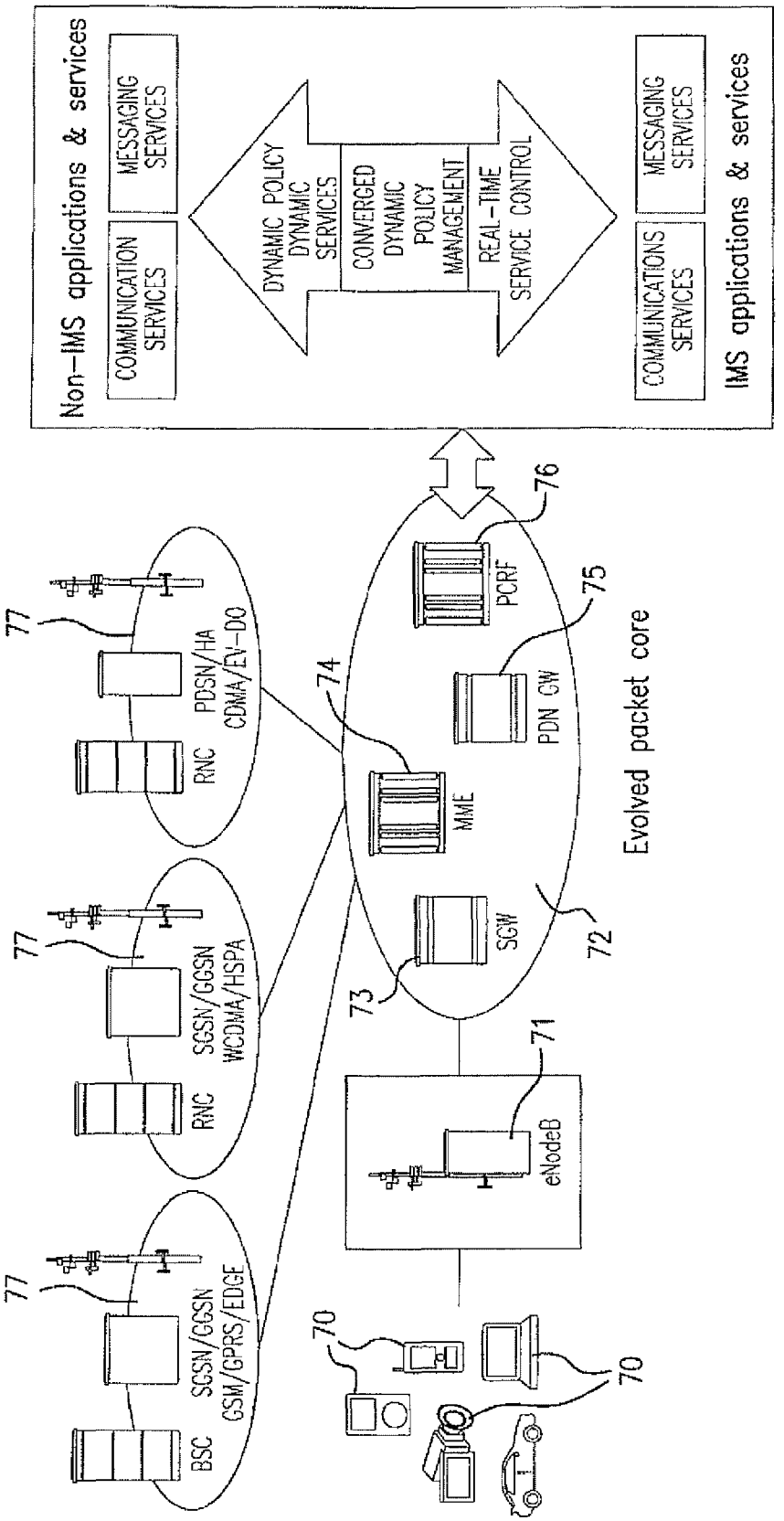

Non-IMS applications & services
COMMUNICATION SERVICES
MESSAGING SERVICES
DYNAMIC POLICY DYNAMIC SERVICES
CONVERGED DYNAMIC POLICY MANAGEMENT
REAL-TIME SERVICE CONTROL
IMS applications & services
COMMUNICATIONS SERVICES
MESSAGING SERVICES
76
PCRF
75
PDN GW
74
MME
SGW
73
72
Evolved packet core
71
eNodeB
70
70
77
BSC
SGSN/GGSN
GSM/GPRS/EDGE
77
RNC
SGSN/GGSN
WCDMA/HSPA
77
RNC
PDSN/HA
CDMA/EV-DO

FIG. 7

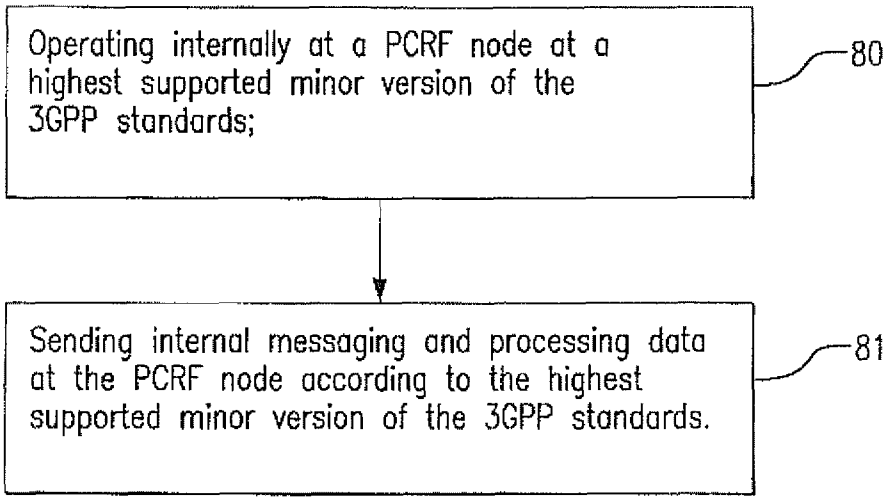

Operating internally at a PCRF node at a highest supported minor version of the 3GPP standards;
80
Sending internal messaging and processing data at the PCRF node according to the highest supported minor version of the 3GPP standards.
81

FIG. 8

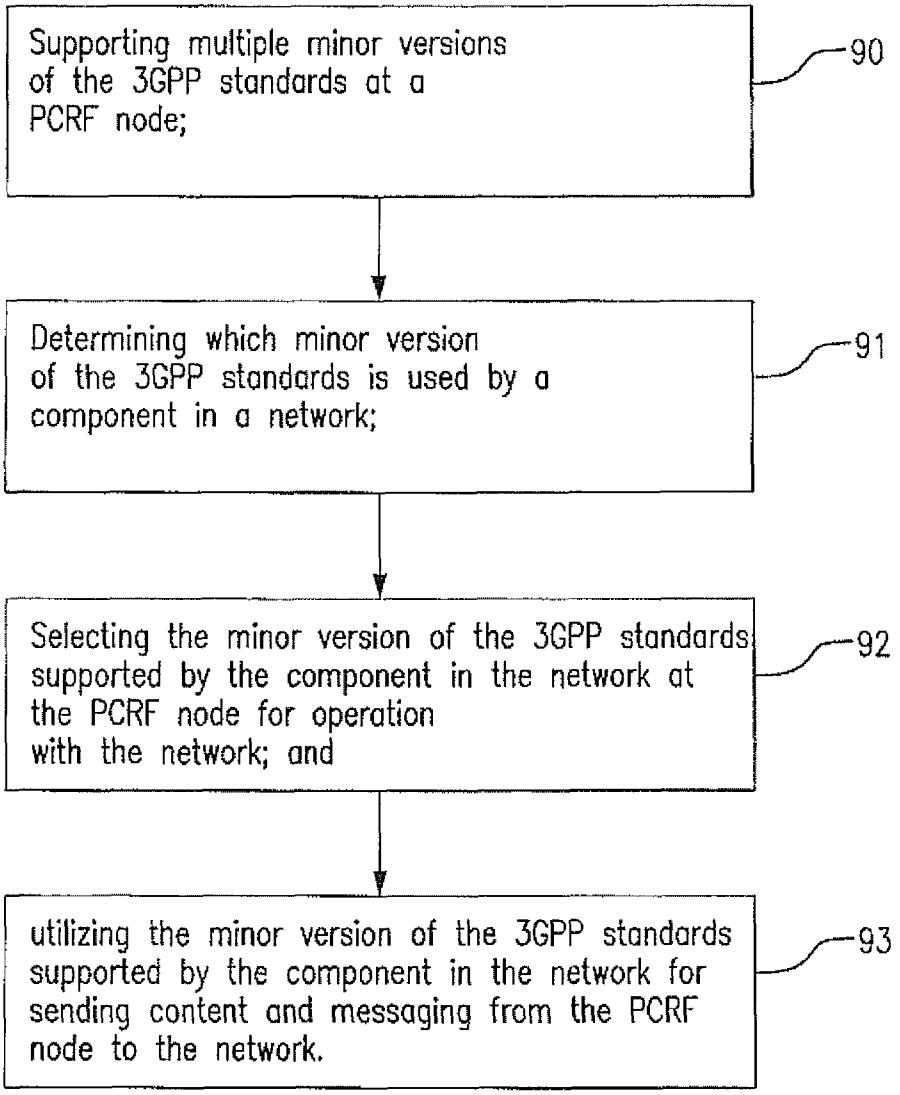

Supporting multiple minor versions of the 3GPP standards at a PCRF node;
90
Determining which minor version of the 3GPP standards is used by a component in a network;
91
Selecting the minor version of the 3GPP standards supported by the component in the network at the PCRF node for operation with the network; and
92
utilizing the minor version of the 3GPP standards supported by the component in the network for sending content and messaging from the PCRF node to the network.
93

FIG. 9

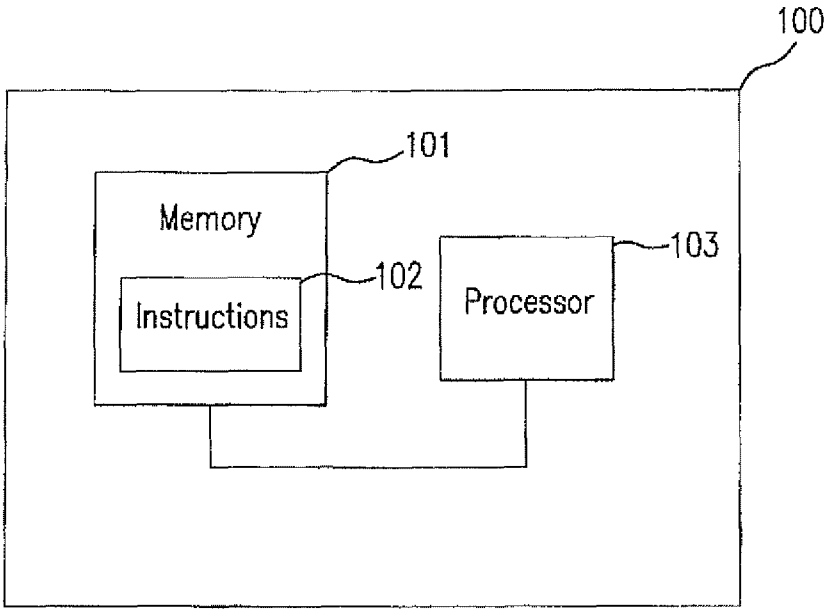


FIG. 10

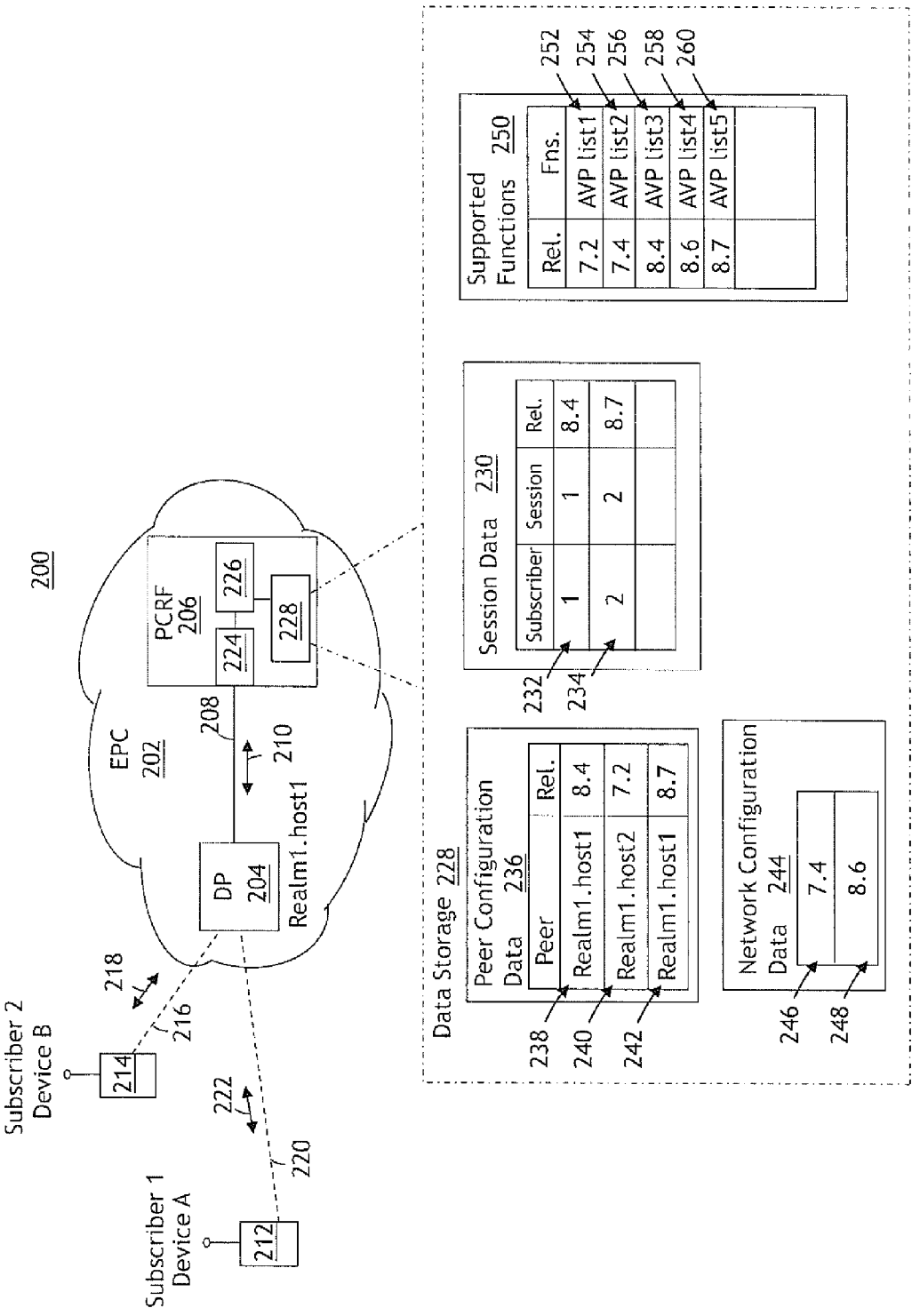

200
EPC 202
PCRF 206
224
226
228
DP 204
Realm1.host1
208
210
218
216
222
220
Subscriber 2 Device B
214
Subscriber 1 Device A
212
Data Storage 228
Peer Configuration Data 236
Peer | Rel.
Realm1.host1 | 8.4
Realm1.host2 | 7.2
Realm1.host1 | 8.7
238
240
242
Session Data 230
Subscriber | Session | Rel.
1 | 1 | 8.4
2 | 2 | 8.7
232
234
Supported Functions 250
Rel. | Fns.
7.2 | AVP list1
7.4 | AVP list2
8.4 | AVP list3
8.6 | AVP list4
8.7 | AVP list5
252
254
256
258
260
Network Configuration Data 244
7.4
8.6
246
248

FIG. 11

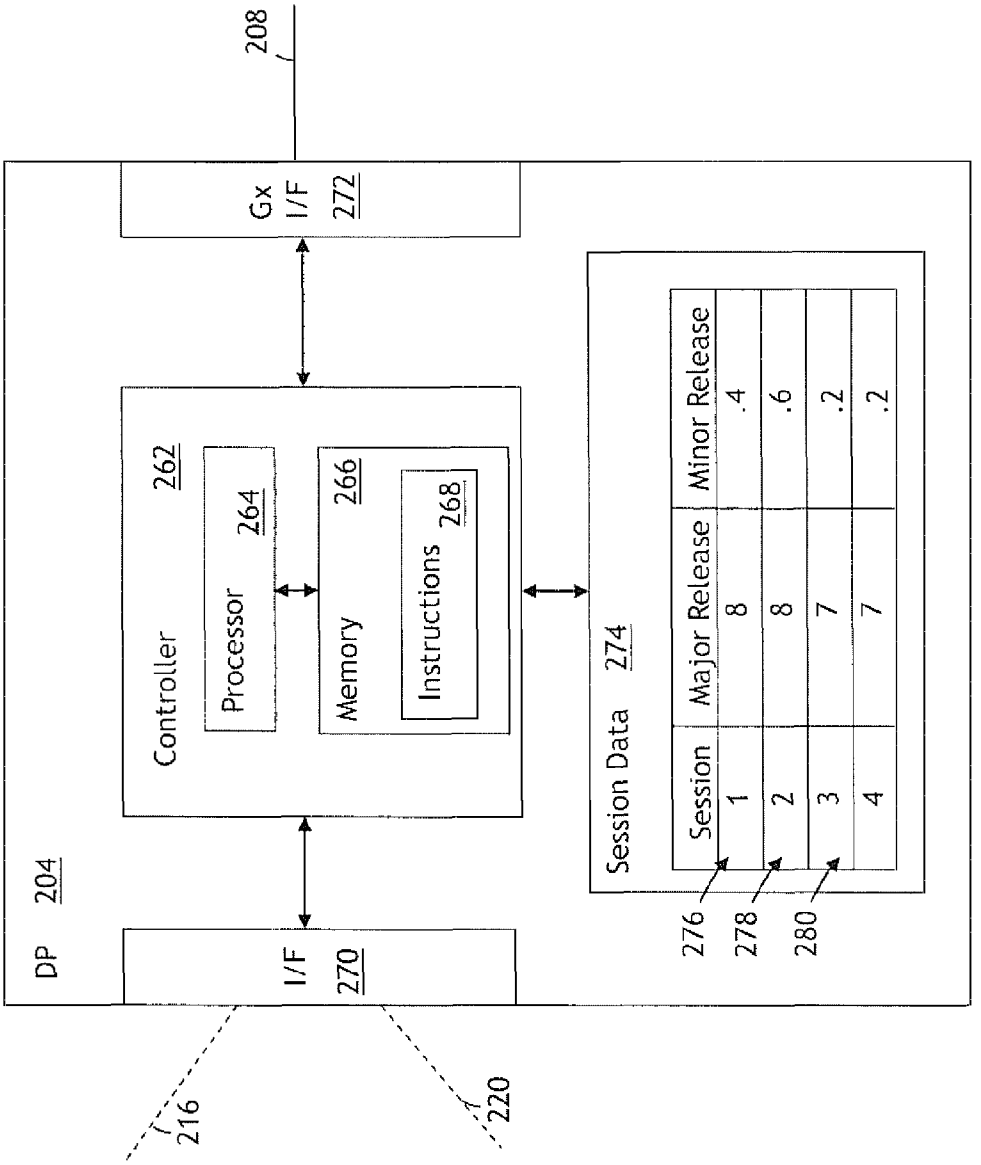

208
Gx I/F 272
DP 204
Controller 262
Processor 264
Memory 266
Instructions 268
I/F 270
Session Data 274
Session
Major Release
Minor Release
1
8
.4
2
8
.6
3
7
.2
4
7
.2
276
278
280
216
220

FIG. 12

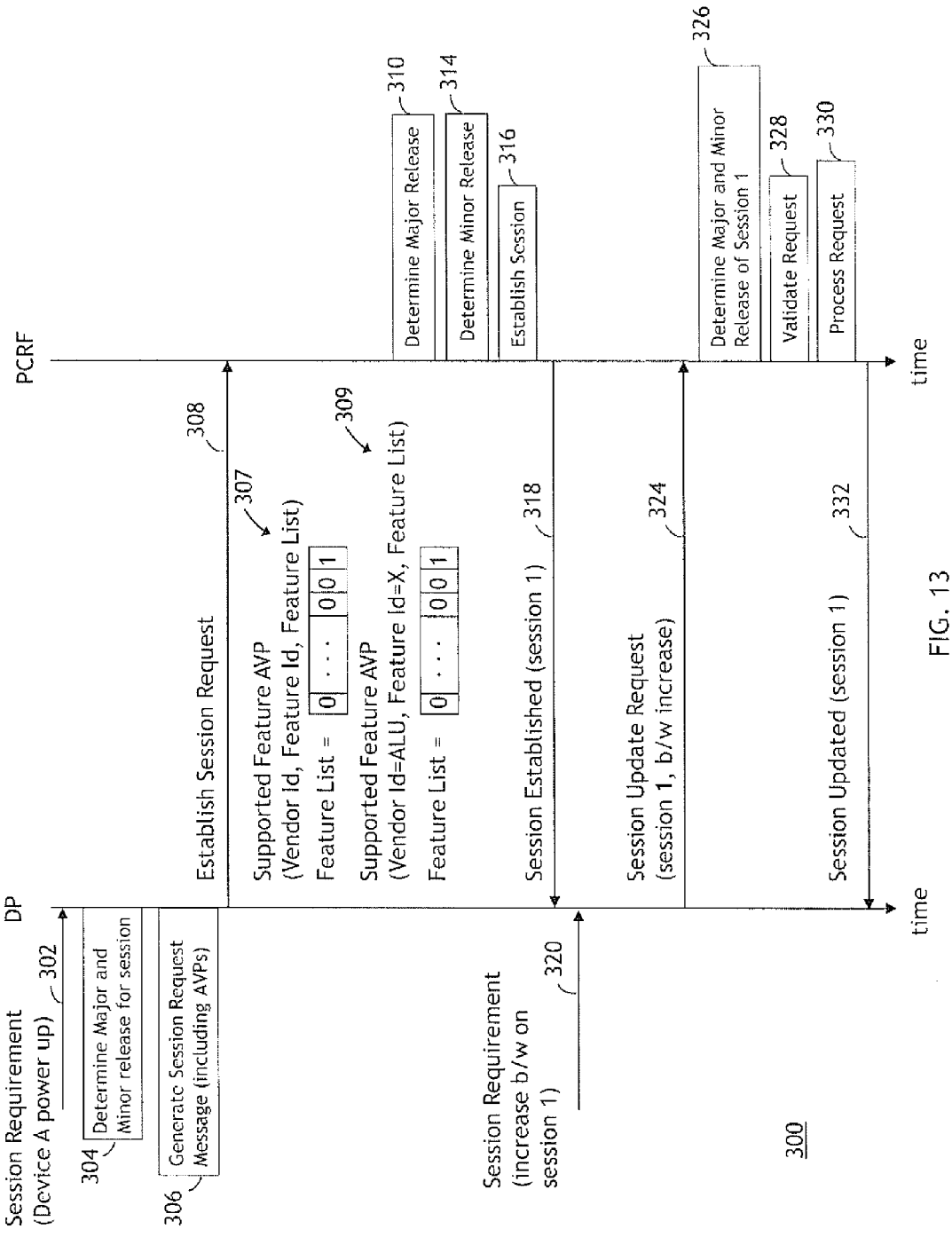

DP
PCRF
Session Requirement (Device A power up)
302
304
Determine Major and Minor release for session
306
Generate Session Request Message (including AVPs)
Establish Session Request
308
Supported Feature AVP (Vendor Id, Feature Id, Feature List)
307
Feature List = 0 · · · 0 0 1
Supported Feature AVP (Vendor Id=ALU, Feature Id=X, Feature List)
309
Feature List = 0 · · · 0 0 1
Determine Major Release
310
Determine Minor Release
314
Establish Session
316
Session Established (session 1)
318
Session Requirement (increase b/w on session 1)
320
Session Update Request (session 1, b/w increase)
324
Determine Major and Minor Release of Session 1
326
Validate Request
328
Process Request
330
Session Updated (session 1)
332
time
time
300

FIG. 13

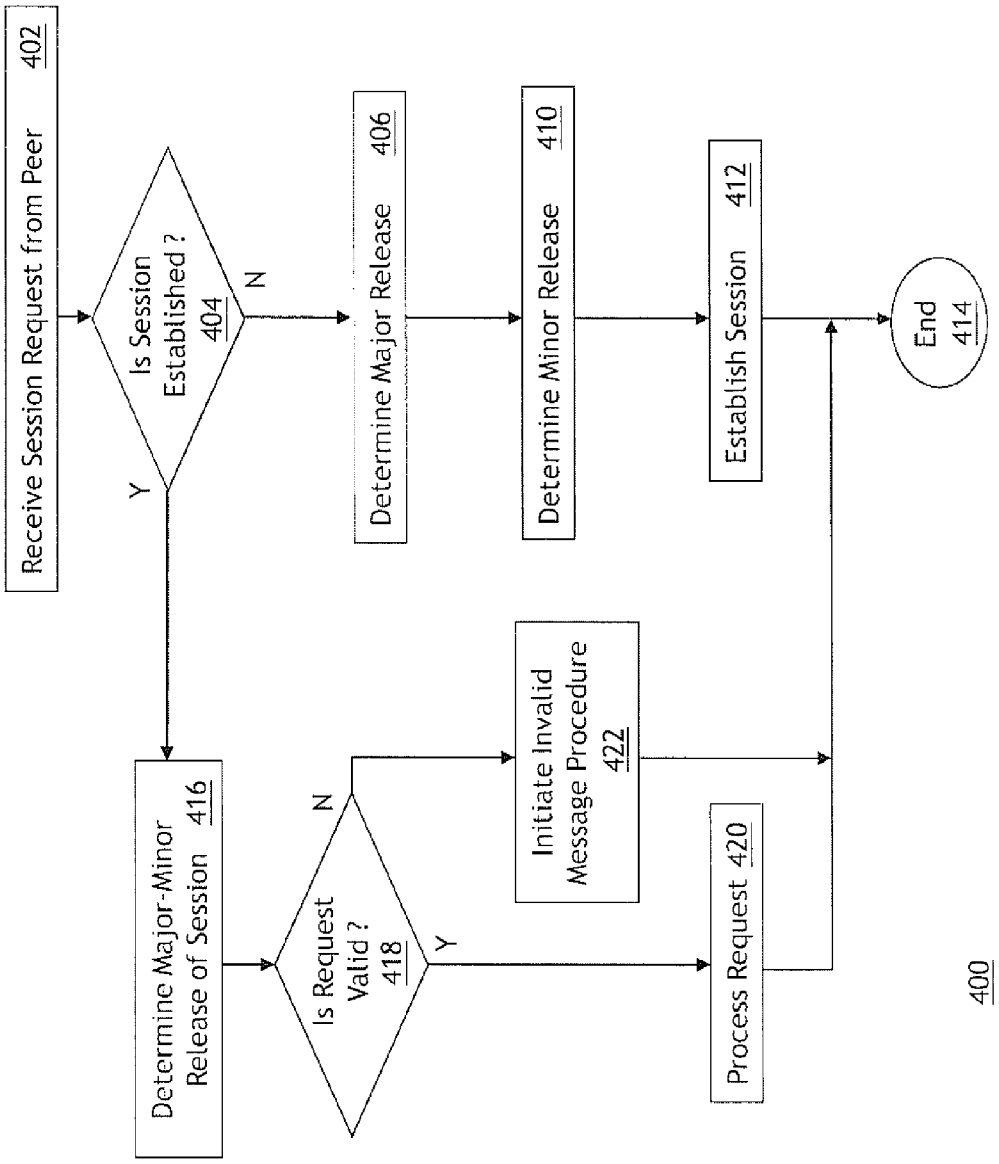

Receive Session Request from Peer 402
Is Session Established ? 404
Y
N
Determine Major Release 406
Determine Minor Release 410
Establish Session 412
End 414
Determine Major-Minor Release of Session 416
Is Request Valid ? 418
N
Y
Initiate Invalid Message Procedure 422
Process Request 420
400

FIG. 14

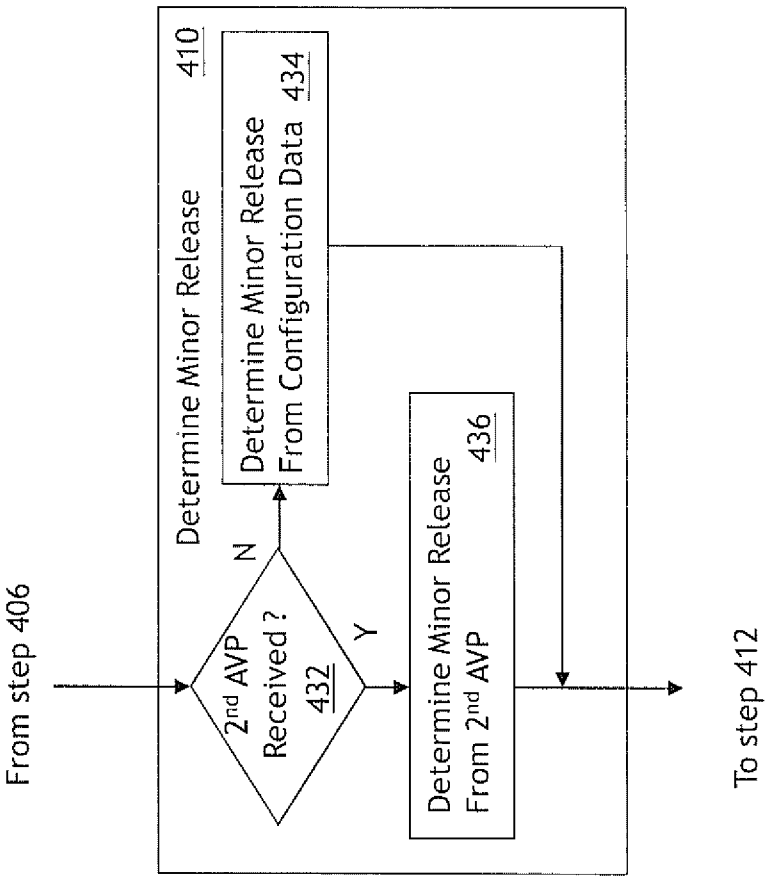

From step 406
Determine Minor Release 410
2nd AVP Received ? 432
N
Y
Determine Minor Release From Configuration Data 434
Determine Minor Release From 2nd AVP 436
To step 412

FIG. 15

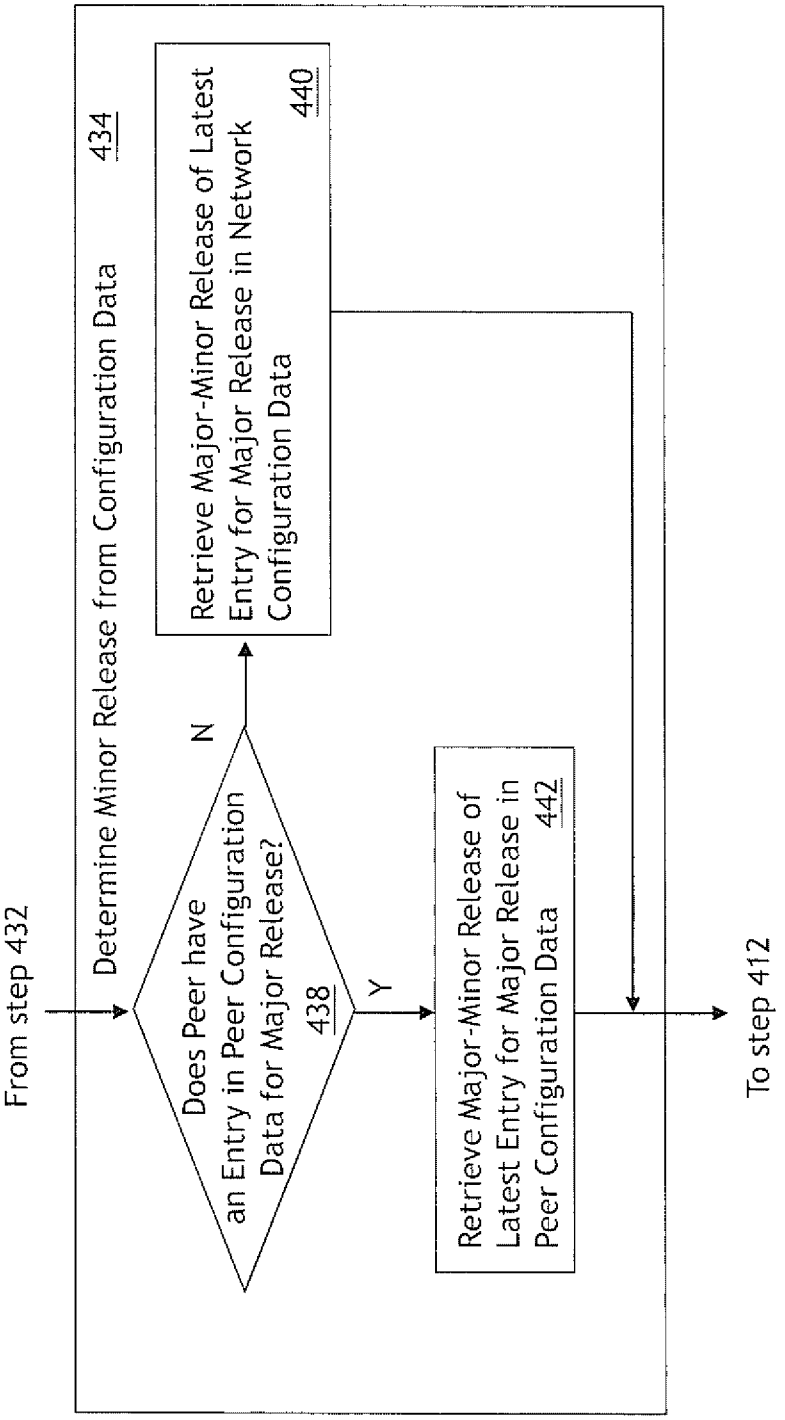

From step 432
Determine Minor Release from Configuration Data 434
Does Peer have an Entry in Peer Configuration Data for Major Release? 438
N
Y
Retrieve Major-Minor Release of Latest Entry for Major Release in Network Configuration Data 440
Retrieve Major-Minor Release of Latest Entry for Major Release in Peer Configuration Data 442
To step 412

FIG. 16

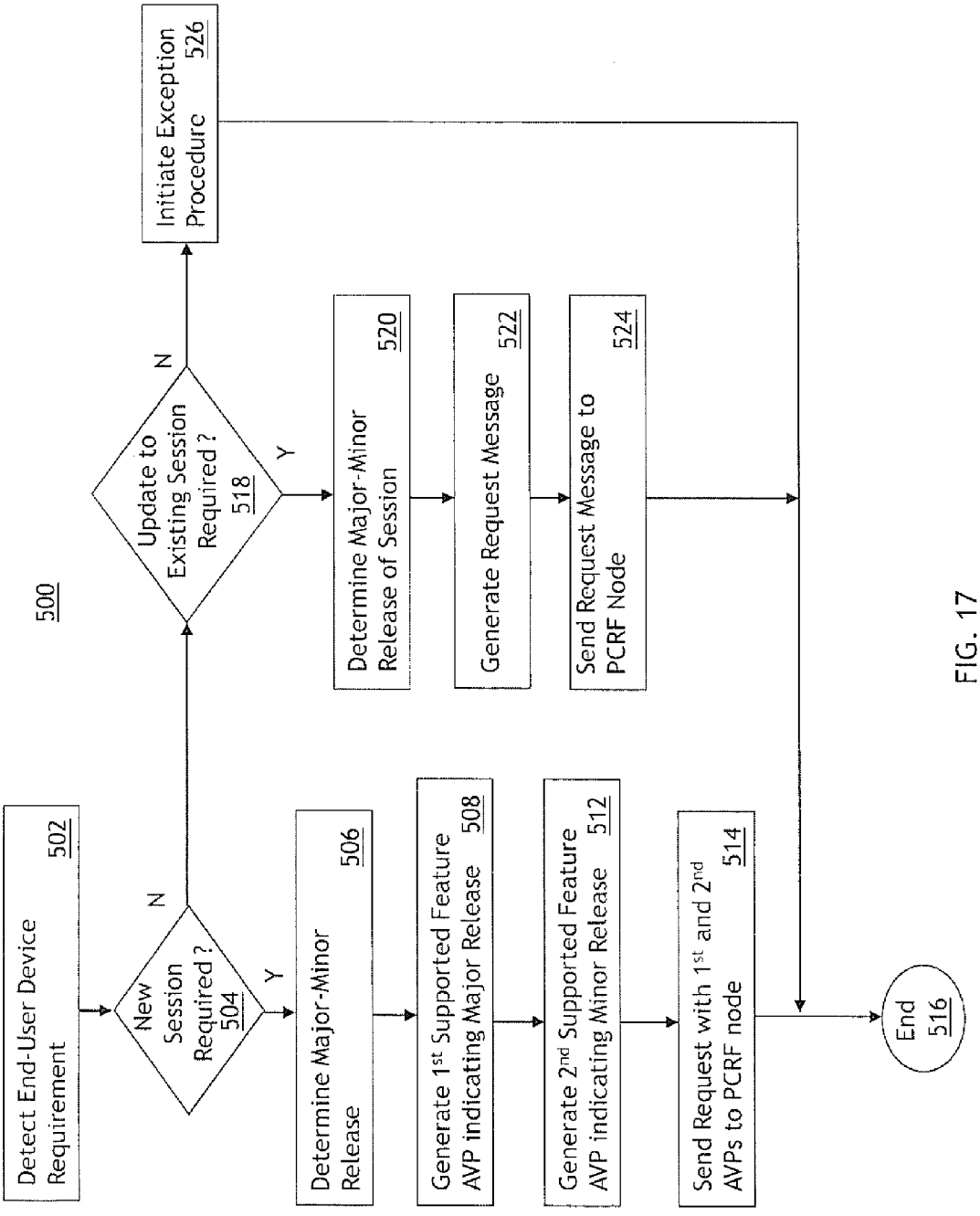

500
Detect End-User Device Requirement 502
New Session Required ? 504
N
Y
Update to Existing Session Required ? 518
N
Y
Initiate Exception Procedure 526
Determine Major-Minor Release 506
Generate 1st Supported Feature AVP indicating Major Release 508
Generate 2nd Supported Feature AVP indicating Minor Release 512
Send Request with 1st and 2nd AVPs to PCRF node 514
Determine Major-Minor Release of Session 520
Generate Request Message 522
Send Request Message to PCRF Node 524
End 516

FIG. 17

SESSION BASED SUPPORT OF MULTIPLE 3GPP STANDARDS VERSIONS

CROSS REFERENCE TO RELATED APPLICATIONS

This United States non-provisional patent application does not claim priority to any United States provisional patent application or any foreign patent application.

FIELD OF THE DISCLOSURE

The disclosures made herein relate generally to the telecommunications industry. The invention discussed herein is in the general classification of a device capable of operation in a mode compatible with different versions of the 3GPP standards and a method for operating according to different versions of the 3GPP standards at the PCRF node.

BACKGROUND

This section introduces aspects that may be helpful in facilitating a better understanding of the invention. Accordingly, the statements of this section are to be read in this light and are not to be understood as admissions about what is in the prior art or what is not in the prior art.

Several technical terms and/or phrases will be used throughout this application and merit a brief explanation.

The 3rd Generation Partnership Project (3GPP) attempts to create a uniform third-generation mobile phone system. 3GPP standards are called releases and different functionality is present in the different versions of the releases.

The 3GPP standards continue to evolve and the major releases of the standards can be differentiated using supported features. However, there also may be differences between minor versions of the 3GPP standards that render them incompatible with each other. It is required that a single release of the Policy and Charging Rules Function (PCRF) be used with different networks operating with different minor versions of the standards.

A base transceiver station (BTS or BS) is used between a mobile phone and a network to permit wireless communication. It can be a radio base station (RBS), node B for 3G networks or enhanced node B for long term evolution (LTE) networks.

A global system for mobile communications (GSM) network includes a network and switching subsystem (NSS) with a mobile switching center (MSC) and associated registers (e.g. home location register (HLR) and visitor location register (VLR)), a base station controller (BSC) and multiple BTSs and an operations support system (OSS).

The GSM originally only involved a circuit switched network for voice calls and short messaging services (SMS). However, it was extended to include packet-switched data services via the General Packet Radio Service (GPRS) core network to permit Internet access.

A MSC is the service delivery node for GSM in charge of routing voice calls. The gateway MSC (GMSC) is an MSC that ascertains the location of a subscriber who is being called by checking the HLR. The gateway MSC also interfaces with the Public Switched Telephone Network (PSTN).

The HER is a central database containing mobile phone subscriber information. A VLR is a temporary database containing information related to mobile phone subscribers that are roaming in an area the VLR serves. Each BTS is served by a VLR.

A gateway GPRS Support Node (GGSN) permits interaction between the GPRS network which is used for transmitting Internet Protocol (IP) packets and external packet switched networks. When a GGSN receives data addressed to a user, it is forwarded to the serving GPRS support node (SGSN) for delivery to the mobile stations in its service area.

System architecture evolution (SAE) is the architecture of 3GPP's LTE wireless communication standard. The evolved packet core (EPC) is the equivalent of GPRS networks and includes a mobile management entity (MME), a serving gateway (SGW), a Public Data Network (PDN) gateway (POW or PDN GW), and a policy and charging rules function (PCRF) node.

The MME is the control node for the LTE network. It tracks mobile devices and selects the SGW for a mobile device. The SGW sends data packets while the PGW permits the mobile phone to connect to external data networks. The PCRF node is a concatenation of Policy Decision Function (PDF) and Charging Rules Function (CRF).

Currently, all components in a network implement the same or compatible minor versions of the 3GPP standards. New product releases are required to implement the supported 3GPP standards version of the network. However, it is not always possible during trials of product releases (i.e. live deployments) to change product releases. It is also a maintenance issue to have multiple versions of a product for the multiple minor versions of the 3GPP standards. There is no means to distinguish between minor versions of the 3GPP standards and/or determine which minor version is being used in a network component.

Hence, there is a need for a device that efficiently, reliably and affordably permits operation in a mode compatible with different versions of the 3GPP standards and a methodology that permits determination and selection of different versions of the 3GPP standards at the PCRF node.

SUMMARY OF THE DISCLOSURE

Some embodiments of the invention enable a device such as a PCRF node to operate with other nodes in an LTE network that are operating at different respective major and minor (hereinafter major-minor) release combinations of the 3GPP standards.

Some embodiments of the invention enable a device such as a PCRF node to operate with another node in an LTE network at a given major-minor release combination of the 3GPP standards with respect to an existing subscriber session (hereinafter referred to simply as a session) and at another major-minor release combination of the 3GPP standards when a new session is established by the device, wherein the major-minor release combination is specified by the node with a request to establish the new session.

According to an aspect of the invention a device for controlling sessions in a network is provided. The device comprises an interface for communicating with an entity operable to send and receive messages regarding a session; data storage adapted to store session data related to the session and to store configuration data corresponding to the entity; and a controller operable to determine, from first and second attribute value pairs (AVPs) of a message received from the entity requesting establishment of a new session, a major-minor release combination under which the new session is to be established, and to determine, from the session data, a major-minor release combination of an existing session responsive to receiving, from the entity, a message regarding the existing session.

Advantageously, by enabling new sessions to be created under various respective major-minor release combinations of the 3GPP standards, each such combination being specified with a request for establishing a corresponding new session, some embodiments of the invention provide session based support of multiple 3GPP standard versions. Enabling new sessions to be established at various major-minor release combination supported by peer nodes in an LTE network provides more support for legacy systems and applications as the LTE network evolves and as the peer nodes therein are upgraded through various 3GPP standard versions.

In some embodiments the controller is further operable to determine from the configuration data, responsive to not receiving the second AVP, the major-minor release combination under which the new session is to be established.

In some embodiments the data storage is further adapted to store network configuration data, and the controller is further operable to determine from the network configuration data, in the absence of configuration data corresponding to the entity, the major-minor release combination under which the new session is to be established.

According to another aspect of the invention a method of controlling sessions performed by a device is provided. The method includes the steps of: receiving a first AVP in a session request from a node; determining if there is an established session corresponding to the session request; and performing the following steps responsive to there not being an established session: determining a major release identifier associated with the first AVP; determining if a second AVP was received in the session request; determining, responsive to receiving the second AVP, a minor release identifier associated with the second AVP; and establishing a session corresponding to the major and minor release identifiers.

In some embodiments the method includes responsive to there not being an established session: determining, responsive to not receiving the second AVP, the minor release identifier from configuration data. Determining the minor release identifier from configuration data in some embodiments may include: determining if there is an entry of peer configuration data corresponding to the node and the major release identifier; retrieving, responsive to there being said entry, a minor release identifier from said entry; and retrieving, responsive to there not being said entry, a minor release identifier from an entry of network configuration data.

In some embodiments of the method, determining the minor release identifier associated with the second AVP may include determining the minor release identifier from a vendor identifier, a feature identifier, and a feature list included in the second AVP.

According to yet another aspect of the invention a network device is provided for servicing session requirements of an end-user device. The network device includes: an interface for communicating with a network node operable to send and receive messages regarding a session; data storage adapted to store session data related to the session; and a controller operable to determine that a new session is required for the end-user device, determine a major-minor release combination under which the new session is to be established, generate a session request including first and second AVPs indicating respectively a major and minor release corresponding to the major-minor release combination, and send the session request to the network node.

In some embodiments of the network device the controller may be further operable to determine that an update to an existing session is required, determine a major-minor release combination of the existing session, generate a session update request specifying a major release corresponding to the major-minor release combination of the existing session, and send the session update request to the network node.

According to still another aspect of the invention a method to be performed by a first network device is provided. The method is a method of servicing session requirements of an end-user device. The method comprises determining if a new session is required for the end-user device, and performing the following steps responsive to the new session being required: determining a major-minor release combination under which the new session is to be established; generating a first AVP for the new session that indicates a major release corresponding to the major-minor release combination; generating a second AVP for the new session that indicates a minor release corresponding to the major-minor release combination; and sending a session request that includes the first and second AVPs to the second network device.

In some embodiments of the method of servicing a session requirement the method may further include responsive to the new session not being required: determining that an update to an existing session is required; determining a major-minor release combination of the existing session; generating a session update request specifying a major release corresponding to the major-minor release combination of the existing session; and sending the session update request to the second network device.

Some embodiments of the methodology may involve supporting multiple minor versions of the 3GPP standards at the PCRF node; determining which minor version of the 3GPP standards is used by a component in a network; selecting the minor version of the 3GPP standards supported by the component in the network; and utilizing the minor version of the 3GPP standards supported by the component in the network for sending content and messaging from the PCRF node.

Some embodiments of the device (e.g. PCRF node) include a memory containing instructions processed by a processor. The instructions may include instructions for operating internally at the PCRF node at a highest supported minor version of the 3GPP standards; sending internal messaging and processing data at the PCRF node according to the highest supported minor version of the 3GPP standards; supporting multiple minor versions of the 3GPP standards at the PCRF node; determining which minor version of the 3GPP standards is used by a component in a network; selecting the minor version of the 3GPP standards supported by the component in the network; and utilizing the minor version of the 3GPP standards supported by the component in the network for sending content and messaging from the PCRF node.

Under some applications, embodiments may provide a reliable device and method that permit selection of different minor versions of the 3GPP standards for operation at the PCRF node.

BRIEF DESCRIPTION OF THE DRAWINGS

Some embodiments of apparatus and/or methods of the present invention are now described, by way of example only, and with reference to the accompanying drawings, in which:

FIG. **1** depicts a 2G/3G mobile generation network and a LTE network.

FIG. **2** depicts a LTE network and the components of the EPC.

FIG. **3** depicts the SGW of a LTE network handling a mobile device moving from a location serviced by a first eNodeB to a location serviced by a second eNodeB.

FIG. **4** depicts one or more service data flows (SDFs) aggregated and carried over bearers.

FIG. **5** depicts three segments that constitute an end-to-end bearer.

FIG. **6** depicts how the PCRF node interfaces with other EPC elements.

FIG. **7** depicts the dynamic nature of policy and mobility management in a LTE network.

FIG. **8** depicts a method of internal operation at the PCRF node according to a first embodiment of the invention.

FIG. **9** depicts a method of operation of the interface components of the PCRF node according to a second embodiment of the invention.

FIG. **10** depicts a device capable of operating according to different minor versions of the 3GPP standards in accordance with a third embodiment of the invention.

FIG. **11** depicts an alternative implementation of the device of FIG. **10** in accordance with a fourth embodiment of the invention.

FIG. **12** depicts an EPC node capable of operating according to different major and minor versions of the 3GPP standards in accordance with a fifth embodiment of the invention.

FIG. **13** depicts operation of the PCRF node and messaging between the PCRF node and an EPC node in accordance with a sixth embodiment of the invention.

FIG. **14** depicts a method of managing sessions performed at the PCRF node in accordance with a seventh embodiment of the invention.

FIG. **15** depicts a step in the method of FIG. **14** in greater detail.

FIG. **16** depicts a step of FIG. **15** in greater detail.

FIG. **17** depicts a method of servicing session requirements performed at an EPC node in accordance with an eighth embodiment of the invention.

DETAILED DESCRIPTION OF THE DRAWINGS

The evolved packet core (EPC) is an all-IP mobile core for the long term evolved (LIE) network that involves a converged framework for packet-based real-time and non-real-time services. The EPC is specified by 3GPP Release 8 that was finalized in the first quarter of 2009.

The EPC provides mobile core functionality that in previous mobile generations (e.g. 2G and 3G) has been realized through two separate sub-domains: circuit-switched (CS) for voice and packet-switched (PS) for data. As shown in FIG. **1**, in previous mobile generations (e.g. 2G and 3G), both voice channels **1** and IP channels **2** are utilized to connect with a BTS **3** or NodeB **4**. This permits transmission to a BSC or RNC **5** connected to a MSC **6** or SGSN **7**. The RNC controls the NodeBs that are connected to it and connects to the circuit switched core network through a media gateway (MGW) **20** and MSC **6** and to the SGSN **7** in the packet switched core network. The MSC **6** permits circuit switched traffic to travel to the PSTN **8** or other mobile networks **9**. The SGSN **7** permits packet switched traffic to travel to a GGSN **10** and onto the Internet **11** or a Virtual Private Network (VPN) **12**. The VPN **12** is an overlay network that permits private data to be sent securely over the Internet. A GMSC **18** responsible for determining which MSC a call recipient is visiting and a softswitch **19** responsible for connecting telephone calls from one phone line to another are also depicted in FIG. **1**.

As shown in FIG. **1**, in a LTE network, these two distinct mobile core sub-domains used for separate processing and switching of mobile voice and data are unified as a single IP domain (IP channel **15**). LTE is an end-to-end all-IP network from mobile handsets and other terminal devices **14** with embedded IP capabilities over IP-based Evolved NodeBs (eNodeBs) **16** (i.e. LIE base stations) and across the EPC **17** and throughout the application domain (both IP Multimedia Subsystem (IMS) and non-IMS).

EPC **17** is essential for end-to-end IP service delivery across the LTE network. The EPC **17** is also instrumental in allowing the introduction of new business models, such as partnering/revenue sharing with third-party content and application providers. EPC **17** promotes the introduction of new innovative services and the enablement of new applications.

EPC **17** addresses LTE requirements to provide advanced real-time and media-rich services with enhanced Quality of Experience (QoE). EPC **17** improves network performance by the separation of control and data planes and through a flattened IP architecture that reduces the hierarchy between mobile data elements (e.g. data connections from eNodeB **16** only traverse through EPC gateways).

FIG. **2** depicts a LTE network with the components of the EPC. FIG. **2** shows the EPC **27** as a core part of the all-IP environment of the LTE network. In the LTE network, the two distinct mobile core sub-domains used for separate processing and switching of mobile voice and data in 2G/3G networks are unified as a single IP domain (IP channel **25**). The LTE network is an end-to-end all-IP network from mobile handsets and other terminal devices **24** with embedded IP capabilities over IP-based Evolved NodeBs **26** and across the EPC **27**.

The introduction of the EPC **27** and all-IP network architecture in the mobile network has profound implications on mobile services, as all voice, data and video communications are built on the IP protocol. EPC **27** also permits interworking of the new mobile architecture with previous mobile generations (e.g. 2G or 3G) and the scalability required by each of the core elements to address dynamic terminal mobility and dramatic increases in bandwidth and the number of direct connections to user terminals. The EPC **27** also increases the reliability and availability delivered by each element to insure service continuity.

To address a radically different set of network and service requirements, the EPC **27** must represent a departure from existing mobile networking paradigms. Introduction of EPC **27** with the LTE network in many ways represents a radical departure from previous mobile paradigms. It signals the end of circuit-switched voice. The LTE network uses a new paradigm for voice traffic called Voice-over-IP (VoIP). This ends a period of more than twenty (20) years during which one application dictated the whole network architecture. EPC **27** treats voice as just one of many IP-based network applications, albeit an important one that requires superb packet network performance and one that is responsible for significant operator revenues.

The LIE network must match and exceed the QoE of wireline broadband. This is quite different from providing best-effort and low-speed web browsing or Short Message Service (SMS) which are two data applications for which the existing PS mobile cores are optimized.

In the LTE network, all mobility management is moved into the mobile core and becomes the responsibility of the MME **29**. This is a consequence of the split of functions previously performed by the RNC/BSC and NodeB/BTS. The MME **29** requires a control plane capacity that is an order of magnitude larger than the SGSN or PDSN and must insure interworking with 2G/3G legacy mobile systems.

The LTE network must provide superior end-to-end Quality-of-Service (QoS) management and enforcement in order to deliver new media-rich, low-latency and real-time services. There is an expected move from four classes of service (CoS) available in 3G to nine QoS profiles with strict performance

targets. This must be achieved while ensuring scalability of users, services and data sessions. In addition, although not a part of the 3GPP Release 8 specification set, deep packet inspection (DPI) and other advanced packet processing are required.

In a LTE network, service control is provided via the Policy and Charging Rules Function (PCRF) **31**. This is a change from previous mobile systems, where service control was realized primarily through user equipment (UE) authentication by the network. The PCRF **31** dynamically controls and manages all data sessions and provides appropriate interfaces toward charging and billing systems as well as enables new business models.

The LTE network requires significantly more capacity in both the data plane and control plane. The existing 2G/3G mobile core elements cannot fully address LTE requirements without a series of upgrades to the platforms. Most of the existing platforms are ill-suited for high-capacity packet processing. Scaling the packet processing requirements on these platforms results in higher consumption of system capacity, high latency, low performance and dramatic performance/feature tradeoffs. In some cases, performance drops more than fifty percent (50%) when features like charging are enabled. Legacy core platforms must dramatically change their product architectures to handle LTE, and even with these architectural changes, they are only a stop-gap solution that may require complex upgrade scenarios to address LTE scalability and performance requirements.

While LTE introduces a clear delineation of the data (user) plane and a control plane, it also imposes two sets of distinct technical requirements on the data plane and control plane. The data plane needs to address requirements for high bandwidth, high availability and scalability with aggregate throughput (per gateway) easily reaching over 100 Gb/s (100 gigabits per second). At the same time, the data plane needs to allow unaffected wirespeed performance with sophisticated processing of millions of service data flows and data bearers turned on while being able to provide sophisticated, fine-granular (per-application, per-service, per-user) QoS. The control plane needs to address the requirements for high scalability and high availability of secure mobility and connection management along with highly reliable and scalable network-wide policy and subscriber management.

The EPC is realized through four new elements: Serving Gateway (SGW) **28**; Packet Data Network (PDN) Gateway (PGW or PDN GW) **30**; Mobility Management Entity (MME) **29**; and Policy and Charging Rules Function (PCRF) **31**.

While SGW **28**, PDN GW **30** and MME **29** were introduced iii 3GPP Release 8, PCRF **31** was introduced in 3GPP Release 7. Until recently, the architectures using PCRF **31** have not been widely adopted. The PCRF's interoperation with the EPC gateways and the MME **29** is mandatory in Release 8 and essential for the operation of the LTE.

FIG. **3** depicts the SGW of a LTE network handling a mobile device moving from a location serviced by a first eNodeB to a location serviced by a second eNodeB. In the LTE network, the two distinct mobile core sub-domains used for separate processing and switching of mobile voice and data in 2G/30 networks are unified as a single IP domain (IP channel **35**). LIE is an end-to-end all-IP network from mobile handsets and other terminal devices **34** with embedded IP capabilities over IP-based Evolved NodeBs **36** and **37** and across the EPC **42**. The EPC **42** has a SGW **38**, a MME **39**, a PDN GW **40** and a PCRF **41**.

The SGW **38** is a data plane element whose primary function is to manage user-plane mobility and act as a demarcation point between the RAN and core networks. SGW **38** maintains data paths between eNodeBs **36** and **37** and the PDN GW **40**. From a functional perspective, the SGW **38** is the termination point of the packet data network interface toward evolved universal terrestrial radio access network (E-UTRAN). When terminals move across areas served by eNodeB elements **36** and **37** in E-UTRAN, the SGW **38** serves as a local mobility anchor. This means that packets are routed through this point for intra E-UTRAN mobility and mobility with other 3GPP technologies such as 2G/GSM and 3G/UMTS.

Like the SGW **38**, the Packet Data Network Gateway (PDN GW) **40** is the termination point of the packet data interface toward the packet data network(s). As an anchor point for sessions toward the external packet data networks, the PDN GW **40** supports: policy enforcement features (e.g. applies operator-defined rules for resource allocation and usage); packet filtering (e.g. deep packet inspection for application type detection); and charging (e.g. per-URL charging).

In LTE, data plane traffic is carried over virtual connections called service data flows (SDFs). SDFs, in turn, are carried over bearers (i.e. virtual containers with unique QoS characteristics).

FIG. **4** depicts one or more SDFs aggregated and carried over bearers. Two SDFs **45** are located in bearer **46** and one SDF **48** is located in bearer **47**.

FIG. **5** depicts three segments that constitute an end-to-end bearer. One bearer, a datapath between a UE (terminal) **50** and a PDN GW **51**, has three segments: radio bearer **52** between UE (terminal) **50** and eNodeB **54**; data bearer **53** between eNodeB **54** and SGW **55** (SI bearer **53**); and data bearer **56** between SGW **55** and PDN GW **51** (S5 bearer **56**).

The primary role of the PDN GW **51** is QoS enforcement for each of these SDFs, while SGW **55** focuses on dynamic management of bearers.

As shown in FIG. **3**, the Mobility Management Entity (MME) **39** is a nodal element within the EPC **42**. MME **39** performs the signaling and control functions to manage the User Equipment (UE)/terminal devices **34** and their access to network connections. The MME **39** also manages the assignment of network resources and the mobility states to support tracking, paging, roaming and handovers. MME **39** controls all control plane functions related to subscriber and session management.

MME **39** manages thousands of eNodeB elements, which is one of the key differences from requirements previously seen in 2G/3G (on RNC/SGSN platforms). The MME **39** is the key element for gateway selection within the EPC **42** (i.e. selection of SGW and PDN GW). The MME **39** also performs signaling and selection of legacy gateways for handovers for other 2G/3G networks. The MME **39** also performs the bearer management control functions to establish the bearer paths that the terminal devices utilize.

The MME **39** supports end-user authentication as well as initiation and negotiation of ciphering and integrity protection algorithms. The MME **39** also handles terminal-to-network sessions by controlling all the signaling procedures used to set up packet data context and negotiate associated parameters like QoS. The MME **39** further is responsible for idle terminal location management by using a tracking area update process to enable the network to join terminals for incoming sessions.

The major improvement provided in Release 7 of the 3GPP standards, in terms of policy and charging, is the definition of a new converged architecture to allow the optimization of interactions between the Policy and Rules functions. Release 7 of the 3GPP standards involves a new network node, Policy

and Charging Rules Function (PCRF) node **41**, which is a concatenation of Policy Decision Function (PDF) and Charging Rules Function (CRF).

Release 8 further enhances PCRF functionality by widening the scope of the Policy and Charging Control (PCC) framework to facilitate non-3GPP access to the network (e.g. WiFi or fixed IP broadband access). In the generic policy and charging control 3GPP model, the Policy and Charging Enforcement Function (PCEF) is the generic name for the functional entity that supports service data flow detection, policy enforcement and flow-based charging. The Application Function (AF) represents the network element that supports applications that require dynamic policy and/or charging control. In the IMS model, the AF is implemented by the Proxy Call Session Control Function (P-CSCF).

FIG. **6** depicts how the PCRF node interfaces with other EPC elements. The PCRF node **61** connects to the AF element **60**, the PGW **63** and the SGW **62**.

FIG. **7** depicts the dynamic nature of policy and mobility management in a LTE network. The LTE network of FIG. **7** is an end-to-end all-IP network from mobile handsets and other terminal devices **70** with embedded IP capabilities over IP-based Evolved NodeBs **71** and across the EPC **72**. The EPC **72** has a SGW **73**, a MME **74**, a PDN GW **75** and a PCRF **76**. The EPC **72** is capable of connecting to a variety of mobile networks **77** and performing dynamic management of mobility, data sessions and network policies.

FIG. **8** depicts a method of internal operation at the PCRF node according to a first embodiment. The methodology involves operating internally at a PCRF node at a highest supported minor version of the 3GPP standards **80**. The highest supported minor version of the 3GPP standards is usually considered the most recent/up-to-date minor version of the 3GPP standards that a given PCRF node supports. Operating internally at a PCRF node at the highest supported minor version of the 3GPP standards may include an operation for sending internal messaging and processing data at the PCRF node according to the highest supported minor version of the 3GPP standards **81**.

FIG. **9** depicts a method of operation of the interface components of a PCRF node according to a second embodiment. An operation for supporting multiple minor versions of the 3GPP standards at the PCRF node **90** is performed. An operation for determining which minor version of the 3GPP standards is used by a component in a network at the PCRF node **91** is performed.

An operation for selecting the minor version of the 3GPP standards supported by the component in the network at the PCRF node for operation with the network **92** is also performed. An operation for utilizing the minor version of the 3GPP standards supported by the component in the network for sending content and messaging from the PCRF node to the network **93** is performed.

Alternatively, an operation for selecting a minor version of the 3GPP standards to be supported by at least one interface component of a PCRF node by a network operator is performed. An operation for operating the at least one interface component at the PCRF node at the minor version of the 3GPP standards selected by the network operator is performed.

FIG. **10** depicts a device in accordance with a third embodiment that is capable of operating according to different minor versions of the 3GPP standards. The device (e.g. PCRF node) **100** includes a memory **101** containing instructions **102** processed by a processor **103**. The instructions may include instructions for operating internally at the PCRF node at a highest supported minor version of the 3GPP standards; sending internal messaging and processing data at the PCRF node according to the highest supported minor version of the 3GPP standards; supporting multiple minor versions of the 3GPP standards at the PCRF node; determining which minor version of the 3GPP standards is used by a component in a network; selecting the minor version of the 3GPP standards supported by the component in the network for operation with the network; and utilizing the minor version of the 3GPP standards supported by the component in the network for sending content and messaging from the PCRF node to the network.

Alternatively, the device may contain instructions for selecting a minor version of the 3GPP standards to be supported by at least one interface component of a PCRF node by a network operator and for operating the at least one interface component at the PCRF node at the minor version of the 3GPP standards selected by the network operator.

FIG. **11** depicts an alternative implementation of the device of FIG. **10** in accordance with a fourth embodiment and in context of an LTE network **200** having an EPC **202**. The device is implemented in a PCRF node **206** that communicates Diameter protocol messages **210** with a Diameter Peer (DP) **204** over a link **208**. The Diameter Peer **204** is identified by a realm and hostname, for example "Realm1.host1" as shown in the figure, in accordance with the Diameter Protocol. The DP **204** would typically be a SGW **38** or PDN GW **40** as shown in FIG. **3**. A first wireless device **212** labeled Device A and associated with a first subscriber, Subscriber 1, communicates **222** with the DP **204** over a link **220**, which comprises both wireless and wireline technologies, for example as shown in FIG. **1**. Likewise a second wireless device **214** labeled Device B and associated with a second subscriber, Subscriber 2, communicates **218** with the DP **204** over a link **216**, which also comprises both wireless and wireline technologies.

The PCRF node **206** includes a Gx interface **224** coupled to the link **208** for communicating the Diameter Protocol messages **210** with the DP **204**. Additional Rx and Gxx interfaces as defined by the 3GPP standards may also be additionally or alternatively included. The interface is coupled to a controller **226**, which comprises the memory **101** and the processor **103** shown in FIG. **10**. The controller **226** is coupled to data storage **228** adapted to store, and that in operation stores, peer configuration data **236**, session data **230**, network configuration data **244**, and an indication of supported functions **250**. The controller **226** is operable to perform steps in accordance with an embodiment that will be described later with reference to FIG. **14**. The controller **226** is adapted to be operable as such by programming the memory **101** with the instructions **102**.

The peer configuration data **236** includes entries **238**, **240**, **242** for Diameter Peers and the major-minor release combination under which each was operating at the time the entry was made. For example, a first entry **238** associates the DP **204** by its realm and hostname, Realm1.host1, with a first major-minor release combination shown in the format "major release.minor release", which in this case is "8.4". A second entry **240** associates another Diameter Peer (not shown) having a realm and hostname of "Realm1.host2" with a major-minor release combination of "7.2". A third entry **242**, which is a later entry then the first entry **238**, associates the DP **204** by its realm and hostname of "Realm 1.host1" with a major-minor release combination of "8.7".

The network configuration data **244** includes default network-wide entries **246**, **248** of major-minor release combinations for Diameter Peers. For example, a first default entry **246** indicates a network-wide major-minor release combina-

tion of "7.4", which is in the same "major.minor" format of the peer configuration data previously described. A second default entry **248**, which was entered later than the first default entry **246**, indicates a network-wide major-minor release combination of "8.6". The default network-wide major-minor release combination is used when a Diameter Peer does not have an entry in the peer configuration data **236** for a given major release. As will be described later, the major release may be indicated in a Diameter protocol message **210** received by the PCRF node **206**.

The session data **230** includes session entries **232**, **234** that each associate a subscriber identifier and a session identifier with a major-minor release combination identifier. For example, a first session entry **232** associates the first subscriber. Subscriber 1 identified by a "1" in the entry **232**, and a corresponding session, identified by a "1" in the entry **232**, with a major-minor release combination "8.4", which is in the same "major.minor" format previously described. A second session entry **234** associates the second subscriber, Subscriber 2 identified by a "2" in the entry **234**, and a corresponding session, identified by a "2" in the entry **234**, with a major-minor release combination "8.7". As will be described later, the session data **230** may be used when the PCRF node **206** receives in a Diameter protocol message **210** regarding an existing session.

The indication of supported functions **250** includes entries **252**, **254**, **256**, **258**, and **260**, each that associate a given major-minor release combination with functions supported according to that major-minor release combination. The functions are specified as a list of attribute value pairs (AVPs). The particular AVPs included in a given list are in accordance with those specified by the 3GPP standards for the corresponding major-minor release combination. As will be described later, the indication of supported functions **250** may be used to validate a Diameter protocol message **210** received by the PCRF node **206** in dependence upon a major-minor release combination determined for a Diameter peer that sent the message or an established session to which the message **210** relates.

FIG. **12** depicts an EPC node capable of operating according to different major-minor release combinations of versions of the 3GPP standards in accordance with a fifth embodiment. In this case the EPC node is represented by the DP **204**, as previously described. The DP **204** includes a controller **262** that comprises a processor **264** that is in communication with a memory **266** programmed with instructions **268**. The controller **262** is operable to perform steps in accordance with an embodiment that will be described later with reference to FIG. **17**. The controller **262** is adapted to be operable as such by programming the memory **266** with the instructions **268**. The DP **204** further includes an interface **270** for coupling to the links **216**, **220** for communicating with the subscriber devices, Device A and Device B, as previously described. The DP **204** also has an interface, referred to as a Gx interface, for communicating Diameter protocol messages with the PCRF node **206**, or other nodes using the Diameter protocol, over the link **208** as previously described. The DP **204** includes session data **274** that is configured to store, and which in operation stores, information indicating a major-minor release combination under which a given session is operating. For example, a first entry **276** for a first session indicated with a "1", is associated in this manner to a major release "8" and a minor release "0.4", which is a major-minor release combination of "8.4". Likewise a second entry **278** associates a second session "2" with a major-minor release "8.6"; and a third entry **280** associates a third session "3" with a major-minor release "7.2".

FIG. **13** depicts operation of the PCRF node **206** and an EPC node, and the messaging between them in accordance with a sixth embodiment. In this case the EPC node is represented by the DP **204**, as previously described. The origination and termination of messages at the DP **204** and PCRF node **206**, and the respective operations, are depicted along two vertical lines labeled DP and PCRF with time advancing from top to bottom of the figure. Reference to FIG. **11** is made in the following description.

The scenario starts when the DP **204** receives an indication **302** of a session requirement, for example that Device A has powered up and requires a new session to be established. The DP **204** then determines **304** a major-minor release combination under which the new session should be established. The DP **204** then generates **306** a first supported feature AVP **307** which the DP **204** includes in a first request message **308** to be sent to the PCRF **206** to establish the new session for the Device A. The first AVP **307** is in accordance with Diameter protocol messaging and as defined by the 3GPP standards, particularly the Gx interface, and is referred to herein as simply an AVP. The first AVP **307** includes a vendor identifier, a feature identifier and a feature list. The feature list, as defined by the 3GPP standards, includes an indication of a major release of the 3GPP standard under which the session is to be established, the indication taking the form of a binary word having certain bits set in a predefined manner to indicate the major release. In this case bit **0** of the word is set, which indicates major release 8 is to be used for the session.

The DP **204** also generates **306** a second supported feature AVP **309** which the DP **204** also includes in the first request message **308** to be sent to the PCRF **206** with respect to establishing the new session for the Device A. The format of the second AVP **309** is similar to that of the first AVP **307**; however the content is different, particularly with respect to the feature identifier and the feature list. In the second AVP **309**, the feature identifier has a vendor-specific value, e.g. "X" which is reserved for use by a given vendor as identified by the vendor identifier, e.g. "ALU". The value of the feature identifier in the second AVP **309** means that the feature list of the second AVP **309** includes an indication specifying a minor release under which the new session is to be established. This indication in the feature list takes the form of a binary word having certain bits set in a predefined manner as defined by the vendor to indicate the minor release. In this case bit **0** of the word is set, which indicates minor release "0.4" is to be used for the session. The DP **204** then sends the first request message **308** to the PCRF node **206**.

Upon receiving the first request message **308** the PCRF **206** initiates a step to determine **310** the major release under which the new session should be established, which can be done for example by reading the feature list of the first AVP **307** to detect which bits are set and matching the result to one of the predefined settings defined by the 3GPP standards. The PCRF **206** then initiates a step to determine **314** the minor release under which the new session is to be established, which can be done for example by reading the feature list of the second AVP **309** to detect which bits are set and matching the result to one of the predefined settings defined by the vendor specified by the vendor identifier.

Subsequent to successfully making the determinations **310** and **314** of the major and minor releases, and thereby the major-minor release combination under which the requested session is to be established, e.g. release combination "8.4", the PCRF **206** initiates a step to establish **316** the requested session. Upon successful establishment of the session, the PCRF **206** sends a response message **318** to the DP **204** confirming that the session has been established and provid-

ing an identifier for the session, e.g. session 1. The session identifier, subscriber identifier, and major-minor release combination are written into the first entry **232** of the session data **230**.

At some future time the DP **204** receives another indication **320** of a session requirement corresponding to the Device A in which the first subscriber, subscriber 1, requests an increase in allowed bandwidth on the session 1. This request is but one of many different types of requests that could be made relating to an existing session. Subsequent to receiving the indication **320**, the DP **204** sends a second request message **324** to the PCRF **206** to request an increase to the allowed bandwidth of the session 1. Upon receiving the second request message **324**, the PCRF node **206** initiates a step to lookup the release information corresponding to the session 1. The PCRF node **206** obtains the release information for the session 1 by retrieving the major-minor release combination stored in the first entry **232** of the session data **230**, which combination in this case is "8.4". The PCRF node **206** then validates **326** the second request message **324** in accordance with the release combination under which the session was created. This validation is done by in part by checking the second request message **324** against a list of supported AVPs for the relevant release combination, which list is stored in the information of supported functions **250**. In this case a third entry **256** in the supported functions **250** corresponds to the relevant major-minor release combination of 8.4. Upon successful validation **328** of the second request message **324** the PCRF node **206** processes **330** the second request message **324** and provides the DP **204** with a response message **332** confirming that the requested update to the session 1 has been made. The validation and processing of the second request message **324** being relative to the major-minor release combination may be done to the first session request **308** and future requests as well.

FIG. **14** depicts a method **400** of managing sessions performed at the PCRF node in accordance with a seventh embodiment. The method starts when a request message, also referred to simply as a request, is received **402** from a Diameter peer node, e.g. the DP **204**, For example the request could any of the request messages **308** and **324** shown in FIG. **13**. The PCRF node **206** then determines **404** if an established session is related to the request, e.g. by consulting the session data **230**. Responsive to determining **404** that there is no established session related to the request, the PCRF node **206** determines **406** a major release associated with the request by inspecting the Feature List of the first AVP **307** as previously described with respect to FIG. **13**. The PCRF node **206** then determines **410** the minor release either from the Feature List of the second AVP **309**, as described earlier with respect to FIG. **13**, or in the case that a second AVP as described is not included in the request, from the peer configuration data **236** or network configuration data **244** as will be described later with reference to FIGS. **15** and **16**. The PCRF node **206** then establishes **412** a new session in accordance with the request and execution of the method **400** ends **414**. Establishing **412** the new session may include updating the session data **230** and sending a response message, e.g. response messages **318** to the Diameter peer.

If the PCRF node **206** determines **404** that there is an established session related to the request, then the PCRF node **206** determines **416** the major-minor release combination corresponding to that session, e.g. by consulting the session data **230**. The PCRF node **206** then determines **418** if the request is valid, which determination may include comparing content of the request to the information of supported functions **250** for the major-minor release combination corresponding to that session. For example, the request might include an AVP that does not appear in the supported functions for the corresponding major-minor release combination, in which case the PCRF node **206** would determine **418** that the request is not valid. Responsive to determining **418** that the request is invalid, the PCRF node **206** initiates an invalid message procedure **422**, which among other things could result in the PCRF node **206** sending a response message to the Diameter peer indicating that the request was rejected or failed. After executing, or at least initiating, the invalid message procedure **422** the method **400** ends **414**.

If the PCRF node **206** determines **418** that the request is valid, then the PCRF node **206** processes **420** the request and the method **400** ends **414**. Processing **420** the request may include updating the session data **230** and sending a response message, e.g. response messages **332**, to the Diameter peer.

FIG. **15** depicts a step in the method of FIG. **14** in greater detail. The step of determining **410** the minor release starts by checking **432** if the second AVP **309** was received. If the second AVP **309** was received within the predetermined time interval and the PCRF node **206** determines **436** the minor release from the second AVP **309**, i.e. by reading the Feature List and Feature Identifier in accordance with the Vendor Identifier as previously described with reference to FIG. **13**. The PCRF node **206** then continues to the step of establishing **412** the session. If the second AVP **309** was not received in the request, for example because the second AVP **309** was never included in the request by the Diameter peer then the PCRF node **206** determines **434** the minor release from the peer configuration data **236** or the network configuration data **244**, as will be described in more detail with reference to FIG. **16**. The PCRF node **206** then continues to the step of establishing **412** the session. The Diameter peer may not have sent the second AVP **309** for any of a number of reasons, for example because the Diameter peer does not support a method of servicing session requirements, such as the method that will be described with reference to FIG. **17**, or the operation of the DP **204** described with respect to FIG. **13**.

FIG. **16** depicts a step of FIG. **15** in greater detail. The step of determining **434** a minor release from the configuration data, which includes the peer configuration data **236** and the network configuration data **244**, is performed by determining **438** if the Diameter peer has an entry in the peer configuration data **236** for the major release specified in the first request, e.g. as specified by the feature list included in the first request. To make this determination **438** the PCRF node **206** looks for any entry in the peer configuration data **236** that corresponds to the realm and host name of the Diameter peer and to the major release specified in the first request. For example, the DP **204** has two entries **238** and **242** in the peer configuration data **236** that correspond to its realm and host name. i.e. "Realm1.host1" and to the major release version 8. Responsive to determining **438** that the Diameter peer does have an entry in the peer configuration data **236** corresponding to the major release, the PCRF node **206** retrieves **442** the latest such entry if there is more than one, which in the case of the aforementioned example would be the second entry **242** corresponding to the major-minor release combination "8.7". However, if the PCRF node **206** determines **438** that there is not an entry corresponding to the Diameter peer and the major release specified in the first request, then the PCRF node **206** retrieves **440** from the network configuration data **244** the latest entry of the major-minor release combination for the major release specified in the request. With respect to the aforementioned example regarding major release 8, the PCRF node **206** would retrieve **440** the second entry **248** from the network configuration data **244**, which entry **248** indicates

a major-minor release combination of "8.6". The PCRF node **206** then continues to the step of establishing **412** the session.

FIG. **17** depicts a method **500** of servicing session requirements performed at an EPC node in accordance with an eighth embodiment. For example the EPC node could be the DP **204**. The method **500** starts by detecting **502** an end-user device requirement, for example the indication **302** of a session requirement when the Device A powers up as described previously with respect to FIG. **13**. The DP **204** then determines **504** if a new session is required. If a new session is not required the DP **204** determines **518** if an update to an existing session is required. If an update to an existing session is not required then the DP **204** initiates **526** an exception procedure and the method **500** ends **516**.

If the DP **204** determines **518** that an update to an existing session is required then the DP determines **520** the major-minor release combination of the existing session, for example by consulting the session data **274** as previously described with respect to FIG. **12**. The DP **204** then generates **522** a request message specifying the update to the session that is required. For example, the request could be the session update request **324** as described with respect to FIG. **13**. The DP **204** then sends **524** the generated request message to the PCRF node **206** and the method **500** ends **516**.

If the DP **204** determines **504** that a new session is required then the DP **204** determines **506** the major-minor release combination under which the session is to be established. The DP **204** could make this determination **506** in any one of several ways, for example by consulting configuration data stored on the DP **204**, e.g. similar to the PCRF node's **206** peer configuration data **236** and network configuration data **244**. The DP **204** may also have configuration data specific to the subscriber or application to which the indication **302** of the session requirement pertains. The DP **204** then generates **508** a first supported feature AVP indicating the major release under which the new session is to be established, for example the first AVP **307** as described with reference to FIG. **13**. The DP **204** then generates **512** a second supported feature AVP indicating the minor release under which the new session is to be established, for example the second AVP **309** as described with reference to FIG. **13**. The DP **204** then sends **514** a request message that includes the first and second supported feature AVPs to the PCRF node **206** and the method **500** ends **516**.

It is contemplated that the methods described herein can be implemented as software, including a computer-readable medium having program instructions executing on a computer, hardware, firmware, or a combination thereof. The methods described herein also may be implemented in various combinations on hardware and/or software.

A person of skill in the art would readily recognize that steps of the various above-described methods can be performed by programmed computers and the order of the steps is not necessarily critical. Herein, some embodiments are intended to cover program storage devices, e.g., digital data storage media, which are machine or computer readable and encode machine-executable or computer executable programs of instructions where said instructions perform some or all of the steps of methods described herein. The program storage devices may be, e.g., digital memories, magnetic storage media such as magnetic disks or tapes, hard drives, or optically readable digital data storage media. The embodiments are also intended to cover computers programmed to perform said steps of methods described herein.

It will be recognized by those skilled in the art that changes or modifications may be made to the above-described embodiments without departing from the broad inventive concepts of the invention. It should therefore be understood that this invention is not limited to the particular embodiments described herein, but is of the invention as set forth in the claims.

What is claimed is:

1. A device for controlling sessions in a network comprising:

an interface for communicating with an entity operable to send and receive messages regarding a session;

data storage adapted to store session data related to the session and to store configuration data corresponding to the entity; and

a controller configured to: determine, during the establishment of a new session, a major-minor release combination of a protocol version to be used in the new session from first and second attribute value pairs (AVPs) of a message received from the entity requesting establishment of the new session, and determine, during an existing session, the major-minor release combination of a protocol version to be used in the existing session from the session data responsive to receiving, from the entity, a message regarding the existing session, wherein the first and second AVPs respectively indicate a major release and a minor release corresponding to the major-minor release combination.

2. The device of claim **1** wherein the controller is further configured to determine, during the establishment of a second new session, a major-minor release of a protocol version to be used in the second new session from the configuration data and a first AVP of a message received from the entity requesting establishment of the second new session, responsive to only receiving a single AVP.

3. The device of claim **2** wherein the data storage is further adapted to store network configuration data, and the controller is further operable to determine from the network configuration data, in the absence of configuration data corresponding to the entity, the major-minor release combination under which the new session is to be established.

4. The device of claim **1** wherein the data storage is further adapted to store information corresponding to functions supported by the device for a given major-minor release combination, and the controller is operable to validate, in dependence upon said information, the message regarding the existing session.

5. The device of claim **4** wherein the information corresponding to functions is a list of attribute value pairs (AVPs).

6. The device of claim **1** wherein the device is implemented as a policy and charging rules function (PCRF) node.

7. The device of claim **1** wherein the device is implemented as a circuit card for installation in a network node.

8. The device of claim **1** wherein the entity is a Diameter peer node and the interface is any one of a Gx interface, Rx interface, or Gxx interface for exchanging Diameter messages.

9. A method of controlling sessions performed by a device comprising the steps of:

receiving a first attribute value pair (AVP) in a request from a node;

determining if there is an established session corresponding to the request; and

performing the following steps responsive to there not being an established session:

determining a major release identifier corresponding to a major protocol release version associated with the first AVP based on a requirement indicated by the first AVP;

determining that a second AVP was received in the request;

determining, responsive to receiving the second AVP, a minor release identifier corresponding to a minor protocol release version associated with the second AVP based on a requirement indicated by the second AVP; and

establishing a session in accordance with the protocol version corresponding to the major and minor release identifiers.

10. The method of claim **9** further comprising:

responsive to there not being an established session:

determining, responsive to not receiving the second AVP, the minor release identifier from configuration data.

11. The method of claim **10** wherein determining the minor release identifier from configuration data comprises:

determining if there is an entry of peer configuration data corresponding to the node and the major release identifier;

retrieving, responsive to there being said entry, a minor release identifier from said entry; and

retrieving, responsive to there not being said entry, a minor release identifier from an entry of network configuration data.

12. The method of claim **10** wherein the method is performed by a policy and charging rules function (PCRF) node and the configuration data resides in the PCRF node.

13. The method of claim **9** wherein determining the minor release identifier associated with the second AVP comprises:

determining the minor release identifier from a vendor identifier, a feature identifier, and a feature list included in the second AVP.

14. The method of claim **9** further comprising:

performing the following steps responsive to there being an established session:

determining a major release identifier and a minor release identifier associated with the established session;

determining if the request is valid;

executing an invalid message procedure responsive to the request not being valid; and

processing the request responsive to the request being valid.

15. The method of claim **14** wherein determining if the request is valid comprises comparing an attribute value pair of the request with an indication of attribute value pairs supported by a major-minor release combination corresponding to the major release identifier and the minor release identifier associated with the established session.

16. The method of claim **15** wherein the method is performed by a policy and charging rules function (PCRF) node and the indication of attribute value pairs resides in the PCRF node.

17. The method of claim **9** wherein the method is performed by a policy and charging rules function (PCRF) node.

18. The method of claim **9** wherein the request is formed as a Diameter protocol message.

19. A method of servicing session requirements of an end-user device, the method performed by a first network device and comprising the steps of:

determining if a new session is required for the end-user device; and

performing the following steps responsive to the new session being required:

determining a major-minor release combination under which the new session is to be established;

generating a first attribute value pair (AVP) for the new session that indicates a major release corresponding to the major-minor release combination;

generating a second AVP for the new session that indicates a minor release corresponding to the major-minor release combination; and

sending a session request that includes the first and second AVPs to a second network device.

20. The method of claim **19** further comprising:

performing the following steps responsive to the new session not being required:

determining if an update to an existing session is required; and

performing the following steps responsive to an update to an existing session being required:

determining a major-minor release combination of the existing session;

generating a session update request corresponding to the major-minor release combination of the existing session; and

sending the session update request to the second network device.

21. The method of claim **20** further comprising:

initiating an exception procedure responsive to the new session not being required and to the update to an existing session not being required.

22. The method of claim **19** wherein the method is performed by a Diameter peer node in a long term evolution (LTE) network.

23. The method of claim **19** wherein generating the second AVP comprises:

setting a feature identifier in the second AVP to a value meaning that a feature list in the second AVP will indicate the minor release; and

setting the feature list to indicate the minor release.

24. A network device for servicing session requirements of an end-user device comprising:

an interface for communicating with a network node operable to send and receive messages regarding a session;

data storage adapted to store session data related to the session; and

a controller operable to: determine that a new session is required for the end-user device, determine a major-minor release combination under which the new session is to be established, generate a session request that includes first and second attribute value pairs (AVPs) indicating respectively a major and minor release corresponding to the major-minor release combination, and send the session request to the network node.

25. The network device of claim **24** wherein the controller is further operable to:

determine that an update to an existing session is required,

determine a major-minor release combination of the existing session,

generate a session update request corresponding to the major-minor release combination of the existing session, and

send the session update request to the network node.

26. The network device of claim **24** wherein the network node is a policy and charging rules function (PCRF) node.

27. The network device of claim **24** wherein the network device is implemented as a circuit card for installation in a Diameter peer node and the interface is any one of a Gx interface, an Rx interface, or a Gxx interface for exchanging Diameter protocol messages.

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